Interim Session, American College of Chest Physicians
Denver, Colorado, November 30, December 1, 1952

VOLUME XXII NUMBER 4

DISEASES

of the

CHEST

OFFICIAL PUBLICATION

AMERICAN COLLEGE CHEST PHYSICIANS

PUBLISHED MONTHLY

OCTOBER
1952

EXECUTIVE OFFICE, 112 EAST CHESTNUT STREET, CHICAGO 11, ILLINOIS
PUBLICATION OFFICE, ALAMOGORDO ROAD, EL PASO, TEXAS

Entered as Second Class Matter August 18, 1936, at the Postoffice at El Paso, Texas
Under the Act of Congress of August 12, 1912.
Copyright, 1952, by the American College of Chest Physicians

JACKSON LARYNGOSCOPES

by

Pilling

Pilling supplies the *complete* line of Jackson Laryngoscopes... infant, child, adolescent, adult... made precisely to the specifications of Dr. Chevalier Jackson... for use with or without Jackson Bronchoscopes... specifically adapted to *all* auxiliary equipment in the standard Jackson-type Bronchoscopic Clinic.

"Made by Pilling" is your assurance of the correct design in instrument craftsmanship.

Complete specifications are given in your Pilling Catalog.

Order direct from...

GEORGE P. Pilling & SON CO.

3451 WALNUT ST., PHILADELPHIA

HEADQUARTERS FOR INSTRUMENTS FOR BRONCHOESOPHAGOLOGY

A Standing Invitation: When in Philadelphia, visit our new salesrooms. Free parking for doctors on our private lot.

OPERATION: DEPENDABILITY

1. Before it is approved for shipment, Kodak Blue Brand X-ray Film must prove its uniformity. Hour after hour, day after day, test-strip samples of finished film get critically controlled exposure in this Sensitometer.

2. Every test strip next receives precision processing—in standard solutions—with equipment designed to maintain all factors constant.

3. Kodak-made, this Automatic Recording Densitometer reads and records the densities of each test strip, and experts interpret the resulting sensitometric curves.

Full-size sheets of Blue Brand Film undergo physical tests, x-ray exposure tests, microscopic study both of the surface and of vertical sections, plus an ordeal in the "Corridor of Climates" where the Blue Brand package must show it can endure a wide range of humidity.

BACK OF EVERY RADIOLOGIST using Blue Brand Film stand 63 years of knowledge, experience, and skill in film manufacture—solid assurance of dependability and uniformity—promise of continuing improvement.

EASTMAN KODAK COMPANY
***Medical Division,* ROCHESTER 4, N. Y.**

For superior radiographic results:

Use
Kodak X-ray Film—
Blue Brand

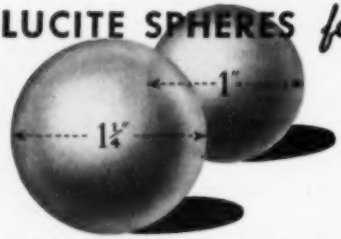
Expose with
Kodak Screens—Contact
(THREE TYPES)

Process in
Kodak X-ray Chemicals
(LIQUID OR POWDER)

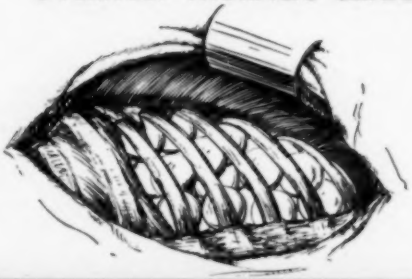
Order from your x-ray dealer

Kodak
TRADE-MARK

LUCITE SPHERES *for Plumbage Thoracoplasty*



. . . as used by the
OVERHOLT THORACIC CLINIC



Lucite Spheres, 1¼" or 1" (in diam.). . . $.30 ea.

Polyethylene Film, Animal Tested, (Used for encasing Spheres)

54" x .015. . . 10 yds. $7.50
54" x .002. . . 10 yds. $7.50

ORDER DIRECT FROM:

ESTABLISHED 1838

Codman & Shurtleff, Inc.

MAKERS OF SURGEONS' INSTRUMENTS

104 BROOKLINE AVENUE BOSTON 15, MASSACHUSETTS

SPECIFY **BIO** VITAMINS

VICAP FORTIOR

BALANCED (Improved) HIGH POTENCY

— For General Therapeutic Use —

A valuable supplement in the regimen of the tuberculosis patient to assist in rectifying deficiencies caused by:

Febrile conditions — Poor Nutrition — Faulty Absorption

Vitamins and Minerals Plus Choline, Inositol and dl-methionine.

VITAMINS, PER CAPSULE:		MINERALS, PER CAPSULE	
Vitamin A (Synthetic Vitamin Palmitate)	12,500 USP Units	Ca (from DiCalcium Phosphate, Anhydrous)	75 mg.
Vitamin D (Irradiated Ergosterol)	1,000 USP Units	P (from DiCalcium Phosphate, Anhydrous)	58 mg.
Vitamin B-1 (Thiamine Hydrochloride, USP)	5 mg.	Fe (from Ferrous Sulfate, Dried, USP)	30 mg.
Vitamin B-2 (Riboflavin, USP)	2.5 mg.	Cu (from Copper Sulfate, Monohydrate)	0.45 mg.
Vitamin B-6 (Pyridoxine Hydrochloride)	0.5 mg.	Mn (from Manganese Sulfate, Dried)	0.5 mg.
Vitamin B-12, USP	1 microgram	K (from Potassium Sulfate)	2 mg.
Vitamin C (Ascorbic Acid, USP)	75 mg.	Mg (from Magnesium Sulfate, Dried)	3 mg.
Niacin Amide, USP	40 mg.	I (from Potassium Iodide, USP)	0.075 mg.
Calcium Pantothenate	4 mg.	Co (from Cobalt Sulfate)	0.04 mg.
Vitamin E (d-alpha Tocopherol Acetate [from vegetable oils] equivalent by biological assay to 2 I. U. Vitamin E)		Mo (from Sodium Molybdate)	0.1 mg.
Folic Acid, USP	0.5 mg.	Zn (from Zinc Sulfate, Dried)	0.5 mg.

Choline Bitartrate, 31.4 mg. Inositol, 15 mg. dl-Methionine, 10 mg.

Biochemical Research Laboratories, Inc.

One East Walton Place Chicago 11, Illinois

DISEASES *of the* CHEST

OFFICIAL PUBLICATION

OF THE

AMERICAN COLLEGE OF CHEST PHYSICIANS

EDITORIAL BOARD

JAY ARTHUR MYERS, M.D., Chairman
Editor-in-Chief
Minneapolis, Minnesota

CHARLES M. HENDRICKS, M.D.
Editor Emeritus
El Paso, Texas

MILTON W. ANDERSON, M.D.
Rochester, Minnesota

RICHARD H. OVERHOLT, M.D.
Brookline, Massachusetts

ANDREW L. BANYAI, M.D.
Milwaukee, Wisconsin

HENRY C. SWEANY, M.D.
Jacksonville, Florida

ASSOCIATE EDITORS

ANTONIO A. ADAMES, M.D. ..... Holtville, California
WILLIAM B. BEAN, M.D. ..... Iowa City, Iowa
EDWARD P. EGLEE, M.D. ..... New York, New York
SEYMOUR M. FARBER, M.D. ..... San Francisco, California
EDWARD W. HAYES, M.D. ..... Monrovia, California
HANS H. HECHT, M.D. ..... Salt Lake City, Utah
PAUL H. HOLINGER, M.D. ..... Chicago, Illinois
CHEVALIER L. JACKSON, M.D. ..... Philadelphia, Pennsylvania
HOLLIS E. JOHNSON, M.D. ..... Nashville, Tennessee
ARTHUR M. MASTER, M.D. ..... New York, New York
EDGAR MAYER, M.D. ..... New York, New York
ALTON OCHSNER, M.D. ..... New Orleans, Louisiana
GEORGE G. ORNSTEIN, M.D. ..... New York, New York
J. WINTHROP PEABODY, M.D. ..... Washington, D. C.
ARTHUR Q. PENTA, M.D. ..... Schenectady, New York
LEO G. RIGLER, M.D. ..... Minneapolis, Minnesota

CORRESPONDING ASSOCIATE EDITORS

Donato G. Alarcon, M.D., Mexico
Adrian Anglin, M.D., Canada
Jose Ignacio Baldo, M.D., Venezuela
Etienne Bernard, M.D., France
Miguel Canizares, M.D., Philippine Is.
Manoel de Abreu, M.D., Brazil
Lopo de Carvalho, M.D., Portugal
Sir Alexander Fleming, England
Ovidio Garcia Rosell, M.D., Peru
Fernando D. Gomez, M.D., Uruguay
Affonso MacDowell, M.D., Brazil
David P. Marais, M.D., South Africa
Amadeo V. Mastellari, M.D., Panama
Gustav Maurer, M.D., Switzerland
Andre Meyer, M.D., France
Papken S. Mugriditchian, M.D., Lebanon
Antonio Navarrete, M.D., Cuba
Juda M. Pauzner, M.D., Israel
Hector Orrego Puelma, M.D., Chile
Raul F. Vaccarezza, M.D., Argentina
Raman Viswanathan, M.D., India
Harry W. Wunderly, M.D., Australia
Attilio Omodei Zorini, M.D., Italy

EXECUTIVE OFFICE
112 East Chestnut Street, Chicago 11, Illinois
MURRAY KORNFELD, *Managing Editor*

VOLUME XXII OCTOBER 1952 NUMBER 4

CONTENTS:

THE STATUS OF TRIED PROCEDURES IN THE TREATMENT OF PULMONARY TUBERCULOSIS 369
William A. Hudson, M.D. and Willard B. Howes, M.D., Detroit, Michigan
Discussion: Henry W. Leetch, M.D., Saranac Lake, New York

ENDOBRONCHIAL TUBERCULOSIS IN CHILDREN 380
John F. Daly, M.D., David S. Brown, M.D., Edith M. Lincoln, M.D. and Virginia N. Wilking, M.D., New York, New York

A CASE OF MULTIPLE PULMONARY INFARCTIONS OCCURRING IN AN AMBULANT MALE, AND ASSOCIATED WITH RECTAL LESIONS 399
Daniel J. Stone, M.D. and Francis J. Lovelock, M.D., Bronx, New York

OPTIMAL TIME OF EXPANSION OF ARTIFICIAL PNEUMOTHORAX . 407
A Study of 445 Adequate Pneumothoraces
Harold Guyon Trimble, M.D., J. Lloyd Eaton, M.D. and Ina Gourley, M.D., Oakland, California

STUDIES OF RESPIRATORY AIR FLOW IN MEASUREMENT OF VENTILATORY FUNCTION 432
Donald F. Proctor, M.D., Baltimore, Maryland
Discussion: George R. Meneely, M.D., Nashville, Tennessee

EXPERIENCE WITH PUTRID LUNG ABSCESS IN NEGRO PATIENTS . 447
Richard A. S. Cory, M.B., Ch.B., Jamaica, British West Indies

A COMPARATIVE STUDY OF THE SUSCEPTIBILITY OF ACID FAST BACILLI TO STREPTOMYCIN, PAS, NEOMYCIN AND 4-ACETYLAMINOBENZALDEHYDE THIOSEMICARBAZONE 458
Arthur H. K. Djang, M.D., Emil Bogen, M.D. and Drake W. Will, B.S., Olive View, California

PERIDURAL ANESTHESIA, AN IMPROVED ANESTHESIA FOR THORACIC SURGERY FROM THE VIEWPOINT OF THE PATIENT, CHEST SURGEON AND PHYSICIAN 466
C. A. Brasher, M.D., Mt. Vernon, Missouri, W. W. Buckingham, M.D., Kansas City, Missouri, O. B. Crawford, M.D., Springfield, Missouri, Poul Ottosen, M.D. and Alan Bailey, M.D., Mt. Vernon, Missouri
Discussion: Philip A. Lief, M.D., Montifiore Hospital, New York, New York

THE RISE AND FALL OF PHYSICAL EXAMINATION IN THE DIAGNOSIS OF DISEASES OF THE CHEST 478
A. E. T. Rogers, M.D. and Emil Bogen, M.D., Olive View, California

COLLEGE CHAPTER NEWS 485

COLLEGE NEWS NOTES 487

OBITUARIES: Donald Francis MacInnis; Seth LeRoy Cox 488
Carl O. Schaefer 489

BOOK REVIEWS: "The Auricular Arrhythmias" 489
"Essentials in Diseases of the Chest" 490

MEDICAL SERVICE BUREAU xxix

COLLEGE EVENTS xxx

Entered as second class matter, August 18, 1936, at the postoffice at El Paso, Tex., under the Act of Aug. 24, 1912

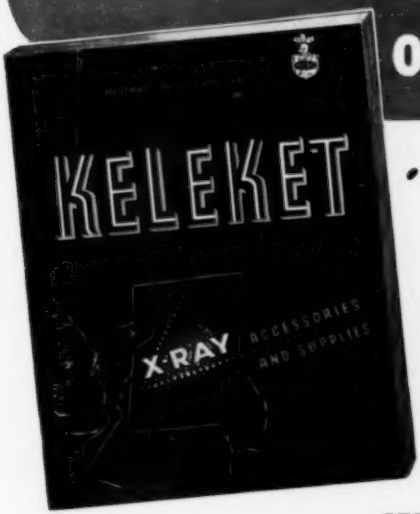
Annual Subscription: United States of America $8.50
Foreign Countries $10.00

IT'S NEW! JUST OUT!

EVERYTHING YOU NEED IN X-RAY ACCESSORIES AND SUPPLIES

from *Keleket* oldest name in X-ray

THIS NEW COMPREHENSIVE CATALOG DESCRIBES & ILLUSTRATES OVER 1,200 ITEMS



... IT'S FREE!

The widest, most complete range of Accessories and Supplies available . . . at your fingertips! New 1953 KELEKET Accessories & Supplies Catalog.

WRITE FOR YOUR FREE PERSONAL COPY OF THIS TIME-SAVING CATALOG TODAY!

. . . have it in your files for ready reference . . . 102 pages with easy-to-find, easy-to-understand data on practically every X-ray accessory and supply item available.

KELEKET
X-RAY CORPORATION
214-10 W. 4th St., Covington, Kentucky

Keleket Service
. . . a complete nation-wide service, expert help in design and planning a radiographic department. Write for complete information.

KELEKET X-RAY CORPORATION
214-10 W. 4th St., Covington, Kentucky

Please send my free copy of the 1953 KELEKET Accessories and Supplies Catalog.

Name _____ Title _____

Hospital _____

Address _____

City _____ Zone _____ State _____

FIFTH ANNUAL POSTGRADUATE COURSE IN DISEASES OF THE CHEST

Sponsored by the

COUNCIL ON POSTGRADUATE MEDICAL EDUCATION

of the

American College of Chest Physicians

In Cooperation With the

NEW YORK STATE CHAPTER

and the

Medical Schools and Hospitals of New York City

HOTEL NEW YORKER
New York City

NOVEMBER 10 - 14, 1952

— TUITION: $50.00 —

The Most Recent Advances in the management and treatment of chest diseases will be discussed.

Registration Will Be Limited

- - - - - - - - - - - - - -

American College of
Chest Physicians
112 East Chestnut Street
Chicago, Illinois

Enclosed you will please find my registration fee in the amount of $50.00 for the Fifth Annual Postgraduate Course in Diseases of the Chest to be held in New York City.

Name .....

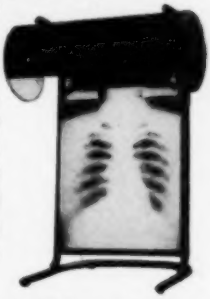
Address .....

City .....

State .....

POWERS X-RAY PAPER REDUCES COSTS 50% OR MORE!

For most routine work, radiographs of high quality can be made at less than half the usual cost with Powers X-Ray Paper. That is why more and more hospitals are using *both* paper and celluloid base film in their X-Ray departments. Techniques differ only slightly.



Proven in use for over 16 years, Powers X-Ray Paper comes in standard sheet sizes, or perforated rolls for use with the Powers Magazine Cassette.

Let us show you in detail how you can effect substantial savings with Powers X-Ray Paper. Write for complete information and literature.

POWERS X-RAY PRODUCTS, INC.

Reg. U.S. Pat. Off.
POWERS X-RAY PRODUCTS
Group Radiography
Glen Cove, Long Island, N. Y.

Better

for more patients

Pasara Calcium

Granulate

because better

Tolerated

- Therapeutically, Pasara Calcium—a new salt of para-aminosalicylic acid—is fully as effective as the sodium salt. It is rapidly absorbed from the intestinal tract and produces desirably high blood levels (5 to 10 mg. per 100 cc.) within 2 to 3 hours.
- But it presents the distinct advantage of greater tolerability when administered in the form of Pasara Calcium Granulate. In a recent study comprising 14 patients who had reacted adversely to sodium *p*-aminosalicylate, this new compound was shown to be well tolerated, without leading to gastrointestinal or other discomfort in the majority of subjects.
- An additional advantage is that Pasara Calcium may be used in the many instances when increased sodium intake appears undesirable.
- Pasara Calcium is available also in powder, tablet, and capsule forms.

*P*asara Calcium Granulate is supplied in 1 lb. and 25 lb. containers; the powder, also in 1 lb. and 25 lb. containers; 0.5 Gm. tablets and capsules in bottles of 100 and 1,000 respectively.

SMITH-DORSEY, Lincoln, Nebraska
A Division of THE WANDER COMPANY

A *Dorsey* PREPARATION

A NEO-PENIL* CASE HISTORY

(For more information about 'Neo-Penil', see page 26)

Bronchiectasis: Preparation for surgery

Patient: Mr. A.C., age 52, admitted to the hospital November 10. Eleven years' history of bronchitis. In the last 5–6 years he had periodic attacks of severe cough, producing large amounts of purulent, fetid sputum. He had "caught a bad cold" in September and was feeling very poorly, with severe cough, copious expectoration and fever.

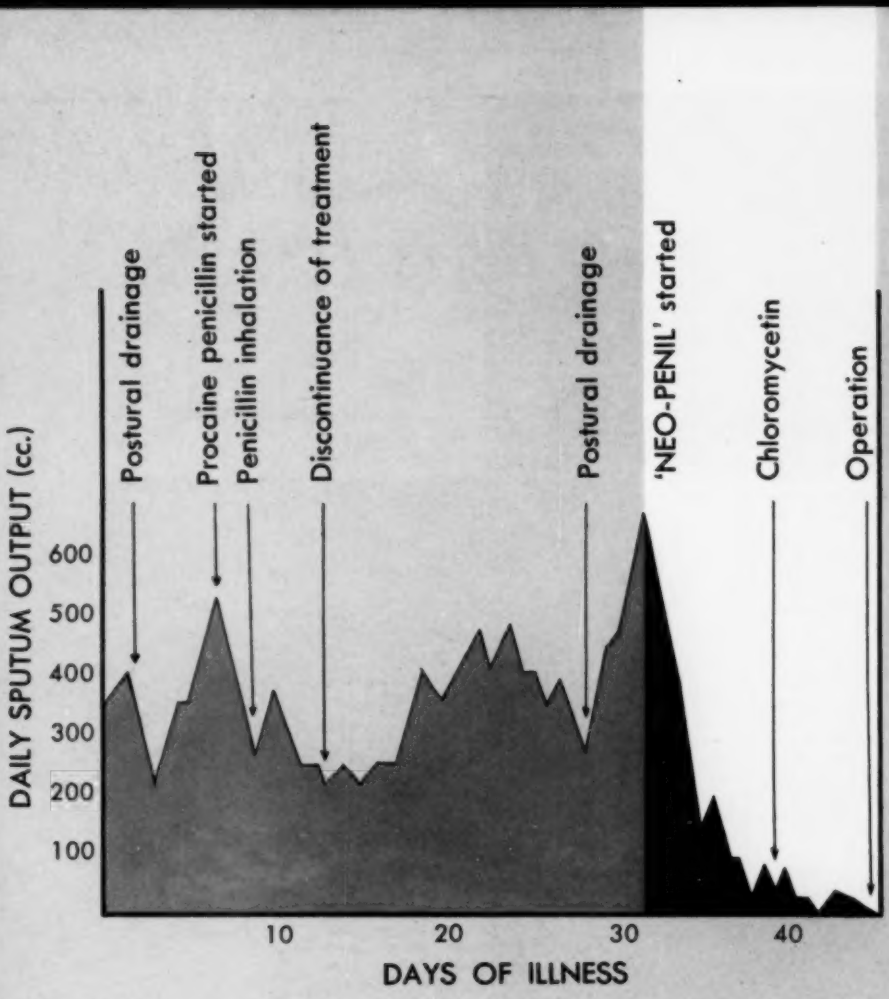
First course of treatment: After sputum cultures were obtained, the patient was treated with procaine penicillin, intramuscularly, 150,000 units daily for 5 days and streptomycin 0.5 Gm. t.i.d. for 4 days. In addition, he was given penicillin inhalations for 6 days. Postural drainage was employed throughout the treatment.

Response: The amount of expectorate decreased but slightly.

On December 4, the patient was transferred to the Department of Thoracic Surgery of a larger hospital, for operation. Bronchoscopic examination revealed marked bronchiectasis in all segments of the left lower lobe. The upper lobe, including the lingula, showed no abnormality. The sputum volume was now 600 cc. per day.

Second course of treatment: In the hope of reducing the sputum volume before operation, the patient was given 'Neo-Penil', intramuscularly, 1 million units the first day, 1 million units b.i.d. the second day, and 1 million units t.i.d. thereafter. Postural drainage was reinstituted.

Response: After 6 days, sputum volume was reduced from 600 cc. to 50 cc. per day. At this time sputum culture revealed penicillin-resistant bacteria and chloromycetin was given, 0.5 Gm. every 6 hours for 5 days. The sputum volume was further reduced, and it was felt safe to operate.



'Neo-Penil' is a new, long-acting derivative of penicillin, which concentrates in the lung and sputum (see page 26). It is available at retail pharmacies in single-dose, silicone-treated vials of 500,000 units.

Smith, Kline & French Laboratories, Philadelphia

FULL INFORMATION ACCOMPANIES EACH 'NEO-PENIL' VIAL.

* T.M. Reg. U.S. Pat. Off. for penethamate hydriodide, S.K.F. (penicillin G diethylaminoethyl ester hydriodide) Patent Applied For

formerly known as 'ISONIZIDE'

Microphotographs of Isoniazid 'Panray' crystals

- 50 Mg. tablets freely available on prescription and for institutional use.
- Other oral, topical and parenteral forms for clinical study.

Write for literature:

THE Panray CORP

340 Canal Street, New York 13, N. Y.

Research and Production for the Medical Profession

When writing please mention *Diseases of the Chest*

Salient facts on the new antituberculous drug...

NYDRAZID

Squibb Isoniazid

	what is known	*what is not known*
Antituberculous effect	Nydrazid has greater potency against the tubercle bacillus than any other known compound, both in vitro and in experimental animals. Clinical results are encouraging. The effect on fever and general status is often dramatic. Roentgenographic improvement occurs often, but is generally slower than in patients treated with streptomycin.	It is too early to predict what the long-term effect of Nydrazid will be. Presumably chronic lesions will not respond better than they do to streptomycin, except insofar as Nydrazid penetrates better. Nydrazid and streptomycin appear to have additive effect in vitro, but it is not known how effective such a combination will be in clinical practice.
Bacterial resistance	Tubercle bacilli with increased resistance to Nydrazid have been isolated from patients. Resistant organisms can also be cultured in vitro, but this phenomenon is virtually eliminated when cultures are exposed to streptomycin and Nydrazid simultaneously.	The clinical implications of bacterial resistance are not completely known. Patients harboring resistant organisms may continue to improve under treatment. The question of delaying the emergence of resistant bacilli by combined therapy must await further study.
Toxicity	Toxic reactions to Nydrazid are chiefly due to stimulation of the central nervous system. They are negligible in the therapeutic dose range, except in patients with convulsive tendencies.	It appears probable that central nervous reactions to Nydrazid can be controlled by barbiturates. But with continued use of the drug, it is not known what sensitivity reactions may occur.

Nydrazid is supplied in 50 and 100 mg. scored tablets, bottles of 100 and 1000.

For further information on Nydrazid send for the Nydrazid Abstract Folder.

SQUIBB

"NYDRAZID" IS A TRADEMARK OF E. R. SQUIBB & SONS

E. R. SQUIBB & SONS
745 Fifth Avenue
New York 22, N. Y.

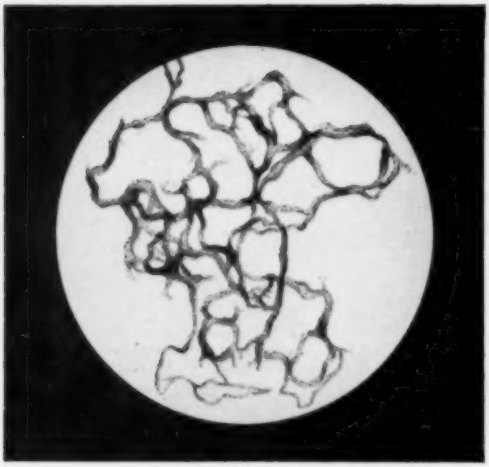
Please send me a copy of the Nydrazid Abstract Folder.

NAME_____

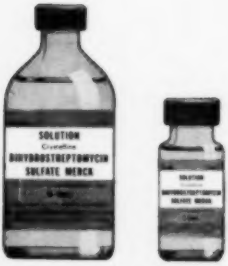
ADDRESS_____

CITY_____ STATE_____

Dept. E



Serpentine growth characteristic of virulent human strains



A ready and tested measure for combating tuberculosis

As therapeutically active as streptomycin, CRYSTALLINE DIHYDROSTREPTOMYCIN SULFATE MERCK is less toxic to the vestibular apparatus, minimizes pain and swelling on injection, and may be used even in some patients allergic to streptomycin.

This preferred product is available in dry powder form and in convenient ready-to-inject form as SOLUTION OF CRYSTALLINE DIHYDROSTREPTOMYCIN SULFATE MERCK.

PARA-AMINOSALICYLIC ACID MERCK (PAS), when used in combination with CRYSTALLINE DIHYDROSTREPTOMYCIN SULFATE MERCK, prolongs the effective period of antibiotic therapy by inhibiting or delaying the development of bacterial resistance.

Crystalline Dihydrostreptomycin Sulfate Merck

Research and Production for the Nation's Health

MERCK & CO., INC.
Manufacturing Chemists
RAHWAY, NEW JERSEY
In Canada: MERCK & CO. Limited – Montreal

© Merck & Co., Inc.

clinically confirmed...

Efocaine®

long-acting local anesthetic-analgesic

for prolonged, non-narcotic control of pain

64 cases — **in surgery of the head, neck and extremities**[1,2]
Postoperatively 35 patients required no narcotics, another 24 required only 1 or 2 doses; no patient required more than 4 doses.

187 cases — **in thoracic and upper abdominal surgery and chest pain**[1,2,3,4]
Postoperative intercostal nerve block with Efocaine allowed patients to breathe deeply and cough freely without pain, obviated the need for respiration-depressing narcotics—"an effective means of preventing postoperative pulmonary complications."[4] "... more than 50 blocks for miscellaneous chest pain ... were all successful."[4]

346 cases — **in lower abdominal surgery**[1,2]
Convalescence was pleasanter and early ambulation was facilitated with Efocaine. In one group of 285 patients, 87 required no postoperative narcotics, and 141 needed only 1 or 2 doses.[2]

246 cases — **in anorectal and vaginal surgery, pruritus ani**[1,2,5,6]
"A dramatic relief of postoperative pain ... in almost every instance ... postoperative narcotic requirements were virtually eliminated."[5]
"All of the patients with pruritus ani were benefited by ... Efocaine."[6]

45 cases — **following tonsillectomy**[7]
"The results ... were most dramatic. A high degree of local pain control was achieved in every instance."

94 cases — **after episiotomy**[8]
"A high degree of episiotomy pain-relief was obtained ... patient morbidity was greatly reduced, and a more pleasant convalescence achieved."

25 cases — **in minor and office surgery**[1]
Relief of postoperative pain was excellent in 76% of the group, good in the remaining 24%.

Clinical experience with EFOCAINE in over 1,000 patients is now recorded in the medical literature. This experience, summarized above, demonstrates unequivocally that EFOCAINE achieves at last a long-sought goal in medicine and surgery: *prolonged, non-narcotic pain control.*

a single injection

- produces 6-12 days local anesthesia-analgesia
- provides dramatic, long-lasting relief of pain
- virtually eliminates postoperative narcotics

safe
nonoily
aqueous-miscible
no vasoconstrictors

1. Ansbro, F. P., and others: Anesthesiology *13*:306, 1952. 2. Jason, A. H., and Shaftel, H. E.: Postoperative Pain Control, presented before the Section on Anesthesiology of the American Medical Association, Chicago, Ill., June 10, 1952. 3. Deaton, W. R., Jr., and Bradshaw, H. H.: Am. Surgeon *18*:616, 1952. 4. Puderbach, W. J., and others: Journal Lancet *72*:203, 1952. 5. Tucker, C. C.: J. Kansas M. Soc. *53*:230, 1952. 6. Gross, J. M., and others: New York State J. Med. *52*:1413 (June 1) 1952. 7. Penn, S. E.: Arch. Otolaryng. *56*:59, 1952. 8. Cappe, B. E., and Pallin, I. M.: Am. Pract. & Digest Treat. *3*:739, 1952.

EFOCAINE, a depot solution, is supplied in 20-cc. multiple-dose vials.
Detailed literature available upon request.

FOUGERA

E. FOUGERA & CO., INC.
75 Varick Street, New York 13, N. Y.

*T. M.

THE **Broyles Bronchoscopic Telescopes**

THREE ANGLES OF VISION

For Optical Visualization of the Tracheobronchial Tree

The three examining telescopes contained in the Broyles Bronchoscope set afford the operator clear, magnified images in the following fields of view:

1. Foroblique*—obliquely forward in direct view.

2. Right Angle—upper lobe bronchus and subdivisions.

3. Retrograde—retrospective view of lower portions of lesions of trachea.

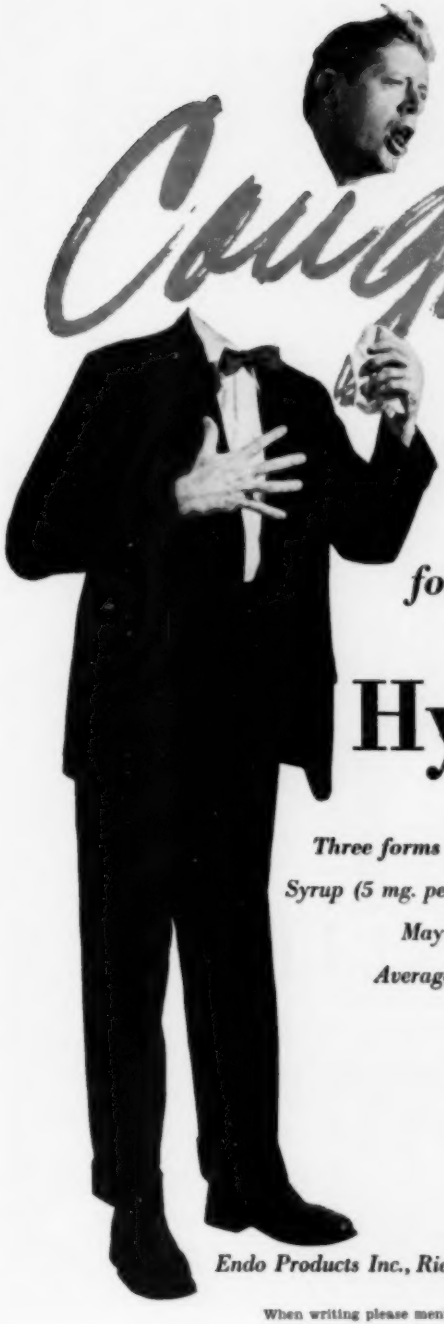
Also included is an *Operating Telescope* providing clear, magnified image directly at jaws of biopsy forceps or grasping forceps. Bronchoscopic tubes, flared at proximal end to facilitate technique, are supplied in lumen sizes 3, 4, 5, 6 mm., 30 cm. long, and with 7, 8, 9 mm. lumen, 40 cm. long. Interchangeable light carriers for each tube, and a set of anti-fogging attachments are also standard equipment. The telescopes may be used with any of the standard bronchoscopic tubes.

*McCarthy Optical System

Write for full information

American Cystoscope Makers, Inc.

1241 LAFAYETTE AVENUE — FREDERICK J. WALLACE, President — NEW YORK 59, N. Y.



Coughing your head off!

for effective cough therapy

Hycodan® BITARTRATE

(Dihydrocodeinone Bitartrate)

Three forms available: Oral Tablets (5 mg. per tablet), Syrup (5 mg. per teaspoonful), Powder (for compounding).

May be habit forming; narcotic blank required.

Average adult dose 5 mg. Literature on request.

Endo®

Endo Products Inc., Richmond Hill 18, N.Y.

chronic cough?
expectoration?

look for bronchiectasis

"[Bronchiectasis] is second only to tuberculosis among chronic pulmonary diseases."[1]

"Any person who has had measles, whooping cough, influenza, pneumonia, acute bronchitis, tonsillitis, sinusitis, compression of the lung by fluid, air or surgery, or any other deformity of the thoracic wall, with cough and expectoration that have persisted for some time should be examined for bronchiectasis."[2]

"... the diagnosis can only be fully confirmed by x-ray of the chest after the instillation of iodized oil (lipiodol) into the air passages."[3]

LIPIODOL*

confirms the diagnosis

* **Lipiodol** (Iodized Oil, U.S.P.) is the registered trademark for the original product created by Lafay. This product alone can bear the name **Lipiodol.** Made in U.S.A.

1. Yater, W. M.: Fundamentals of Internal Medicine, ed. 3, New York, Appleton-Century-Crofts, 1949, p. 315.
2. Myers, J. A., and McKinlay, C. A.: The Chest and the Heart, Springfield, Ill., Charles C Thomas, 1948, p. 307.
3. White, B. V., and Geschickter, C. F.: Diagnosis in Daily Practice, Philadelphia, J. B. Lippincott Co., 1947, p. 419.

FOUGERA

E. FOUGERA & CO., INC., 75 VARICK ST., NEW YORK 13, N. Y.
Canadian Distributors: Vinant, Ltd., Montreal, Canada

*Designed by Dr. Louis R. Davidson, New York City

ABSOLUTE CONTROL

Chest physicians everywhere are increasingly standardizing on the Davidson* Pneumothorax Apparatus for lung collapse work. This foolproof instrument with its highly perfected features safely and efficiently performs all the functions a pneumothorax apparatus may be called upon to render . . . in office, hospital or patient's home . . . to full advantage.

EASY HANDLING

Portable, always ready to use —removable from case

*

No special needles required

*

Single control valve operates reservoirs and manometer

*

No spilling of fluids in reservoirs and manometer tube, with valves closed

EFFICIENT THERAPY

Initial filling under theoretically exact conditions

*

Refills correctly measured

*

Production of high intrapleural pressure (if desired)

*

Safe removal of air from pleural cavities (as in spontaneous pneumothorax)

"The Evolution of Modern Pneumothorax Machines by Dr. Louis R. Davidson, (Am. Rev. Tuberc., November 1939) together with descriptive literature will be mailed on request.

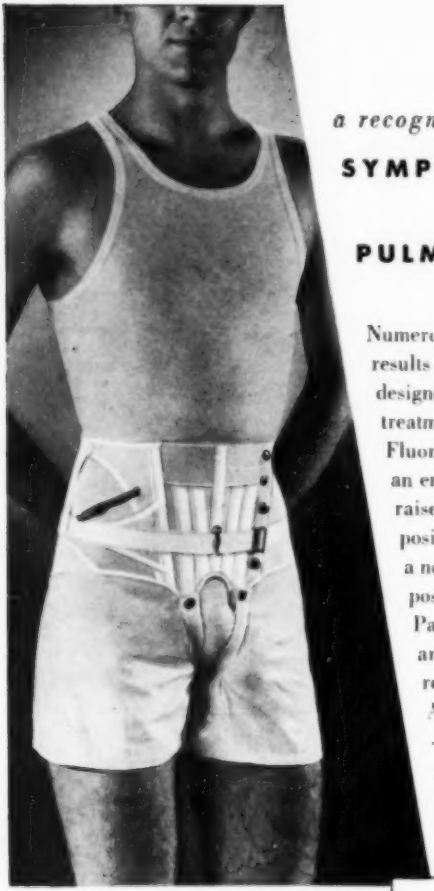
Available through accredited surgical supply distributors

A SKLAR PRODUCT

Davidson Pneumothorax Apparatus

SKLAR

LONG ISLAND CITY, N. Y.



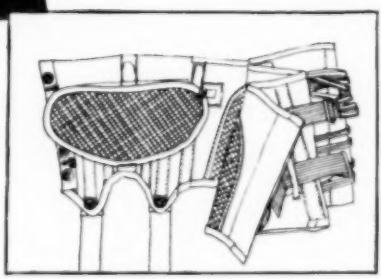
a recognized aid in the

SYMPTOMATIC TREATMENT

of

PULMONARY EMPHYSEMA

Numerous authorities report beneficial results from the use of a properly designed abdominal binder as an aid in the treatment of pulmonary emphysema. Fluoroscopy of patients wearing an emphysema binder shows that it raises the diaphragm toward its expiratory position and helps support the muscle in a normal dome shape. From this position contraction can again occur. Paradoxical movements of the diaphragm are largely prevented and respiration difficulties alleviated. An ingenious inflatable pressure pad — in complete control of the patient — extends its use for those with scaphoid as well as normal abdomens.



The inflatable pad in the Camp Emphysema Binder has a steel plate on the belt side so that all pressure is directed inward. A valve and small detachable bulb for reducing and increasing pressure with posture changes and distention following eating are patient conveniences. The lower edge of the pressure pad comes just above the symphysis pubis; the top falls below the umbilicus.

S. H. CAMP and COMPANY, JACKSON, MICHIGAN

World's Largest Manufacturers of Scientific Supports

Offices in New York • Chicago • Windsor, Ontario • London, England

When writing please mention *Diseases of the Chest*

After more than a decade...

PYRIZIDIN*

(Nepera Brand of Isoniazid)

a notable advance in tuberculosis therapy

Pyrizidin (Nepera's isonicotinic acid hydrazide) is the result of more than ten years of intensive research in the chemotherapy of tuberculosis at the laboratories of Nepera Chemical Co., Inc.

The definite anti-tuberculosis activity and therapeutic effectiveness of Pyrizidin have been confirmed by careful laboratory and clinical investigation. Extensive clinical studies, now in progress, demonstrate that it is a drug of great promise — diminishing fever rapidly, increasing appetite, promoting gain in strength and weight, and decreasing sputum, cough and expectoration.

Pyrizidin is preferably used in a combined regimen with streptomycin and dihydrostreptomycin since combined treatment decreases the chances for the development of complete bacterial resistance. It should be used alone when intolerance or hypersensitivity to these drugs has been demonstrated.

Dosage: **The recommended daily dosage of Pyrizidin is 3 to 5 mg. per Kg. of body weight in divided doses. Larger doses must be administered with caution, and the use of laboratory facilities for the detection of toxicity must be available. In the treatment of miliary tuberculosis, tuberculous meningitis, tuberculous pneumonia, and other life-threatening forms, a daily dosage as high as 7 mg. per Kg. may be used for a period of ten days.**

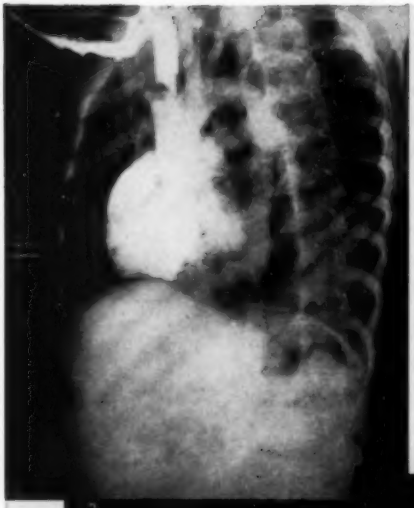
Supplied: **in scored, uncoated tablets of 50 mg., bottles of 100 and 1000.**

Now available for prescription at local pharmacies everywhere.

Nepera Chemical Co., Inc.
Pharmaceutical Manufacturers
Nepera Park Yonkers 2, N. Y.

NEPERA

*Trademark of Nepera Chemical Co., Inc. for its brand of isoniazid (formerly spelled "Pyrizidin")



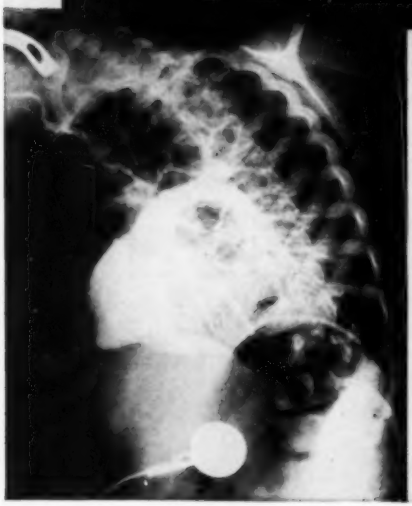
Angiocardiography

Angiocardiography with Diodrast 70 per cent solution — whether by means of intravenous injection or by the technic of intracardiac catheterization — is now a well standardized and often immensely helpful procedure.

Diodrast

Concentrated Solution 70%

Ampuls of 20 cc. and 50 cc.



Specific instances in which it may be of unsurpassed diagnostic value are congenital lesions such as patent ductus arteriosus, tetralogy of Fallot, coaretation of the aorta, patent foramen ovale, dextrocardia, etc.; aneurysms, mediastinal lesions and chronic pericarditis.

Winthrop-Stearns INC.

NEW YORK 18, N. Y. WINDSOR, ONT.

Diodrast, trademark reg. U. S. & Canada, brand of iodopyracet

NEW

NEBULIZATION of Tryptar by standard aerosol technique marks a NEW ADVANCE in the management of respiratory disorders associated with hypersecretion and accumulation of fibrinomucinous material.

(Limber, C. R.; Reiser, H. G.; Roettig, L. C., and Curtis, G. M.: Enzymatic Lysis of Respiratory Secretions by Aerosol Trypsin, J.A.M.A. 149: 816-821, (June 28) 1952.

Tryptar* Aerosol

in Bronchial Asthma

in Purulent Bronchitis

in Bronchiectasis

The powerful digestant action of Tryptar upon fibrin and respiratory tract mucin rapidly liquefies heavy, thick, tenacious bronchial secretions and flushes the respiratory pathways. Previously abundant expectoration dramatically decreases, putrid sputum changes its obnoxious character, and there is greater ease in breathing. Sleep, appetite, weight and well-being improve rapidly and the patient may be symptom-free for prolonged periods.

Tryptar Aerosol has produced excellent results in bronchial asthma, acute and chronic purulent bronchitis, bronchiectasis, emphysema, atelectasis and selected cases of pneumonitis, based upon extensive clinical investigations.

Tryptar* Aerosol

*The Armour Laboratories Brand of Purified Crystalline Trypsin, the proteolytic enzyme that selectively digests necrotic tissue and removes debris without injury to living tissue.

Tryptar Aerosol is supplied in a package containing: 125,000 Armour Units (125 mg. of tryptic activity) of highly purified crystalline trypsin per vial, plus an ampule containing 3 cc. of Tryptar Diluent.

THE ARMOUR LABORATORIES CHICAGO 11, ILLINOIS

world wide dependability

PHYSIOLOGIC THERAPEUTICS THROUGH BIORESEARCH

When writing please mention *Diseases of the Chest*

••1952••

DIRECTORY

American College of Chest Physicians

The NEW — UP TO-DATE Membership Directory of the American College of Chest Physicians is NOW available.

- **GEOGRAPHICAL ROSTER**
- **BIOGRAPHICAL DATA**
- **ALPHABETICAL INDEX**
- **COLLEGE BY-LAWS**

— Over 600 pages —

— Price: $7.00 postage prepaid —

— A valuable adjunct to your Library —

— — — — — — — — — — — — — — — —

American College of Chest Physicians
112 East Chestnut Street, Chicago 11, Illinois

Enclosed you will please find my remittance in the amount of $7.00 for my copy of the 1952 Membership Directory of the American College of Chest Physicians.

NAME ..... ADDRESS .....

CITY ..... STATE .....

Make checks payable to the American College of Chest Physicians.

BACK ON THE NATURE TRAIL

BACK to work, back to his hobbies, back to a normal life. This is the happy result for many chronic asthmatics who are on inhalation therapy with NORISODRINE Sulfate—a quick-acting bronchodilating powder.

The patient is free to come and go as he pleases. He carries this therapy with him. When he feels an attack coming on, he simply takes three or four inhalations of NORISODRINE, using the pocket-sized AEROHALOR, and the bronchospasm usually subsides at once.

Effective against both mild and severe asthma[1,2,3] NORISODRINE is a sympathomimetic amine with a marked bronchodilating effect and relatively low toxicity. With proper administration, side-effects are few and usually minor.

Before prescribing this potent drug, however, please write to Abbott Laboratories, North Chicago, Illinois, for literature describing administration, dosage and precautions. Abbott

EASY TO CARRY
IN POCKET OR PURSE

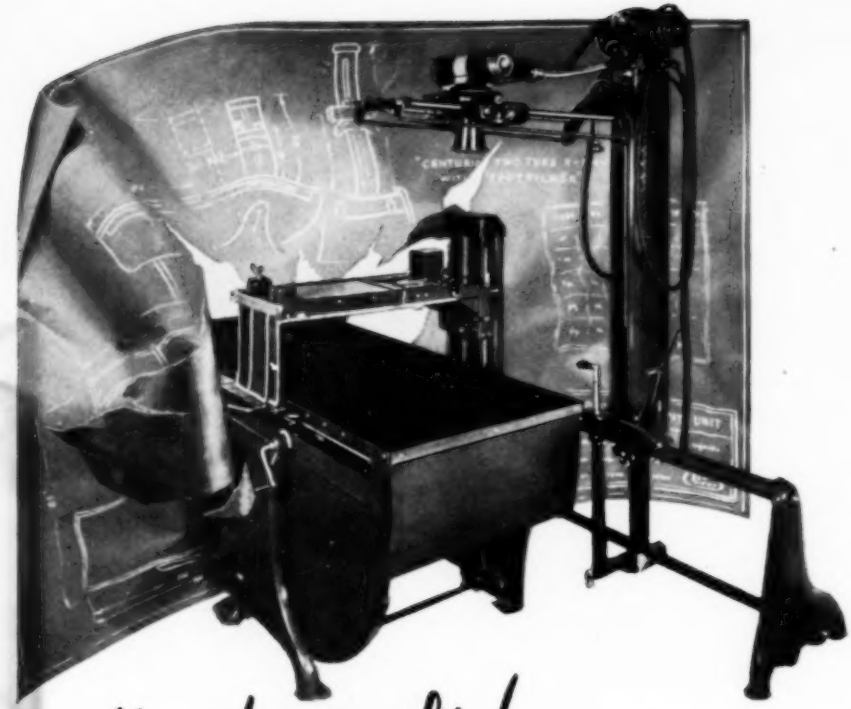
NORISODRINE®

SULFATE POWDER

ISOPROPYLARTERENOL SULFATE, ABBOTT

For Use With the AEROHALOR,® Abbott's Powder Inhaler

1. Kaufman, R., and Farmer, L. (1951), Norisodrine by Aerohaler in Asthma, Ann. Allergy, 9:89, January-February. 2. Swartz, H. (1950). Norisodrine Sulphate (25 Per Cent) Dust Inhalation in Severe Asthma, Ann. Allergy, 8:480, July-August. 3. Krasno, L., Grossman, M. and Ivy, A. (1949), The Inhalation of 1-(3',4'-Dihydroxyphenyl)-2-Isopropylaminoethanol (Norisodrine Sulfate Dust), J. Allergy, 20:111 March.



You asked for this!

You said you wanted a modern two-tube x-ray unit, with an efficient spot-filming device, and a separate over-table tubestand . . . *all this at a moderate price.* You wanted the table to be motor-driven for any angulation over the full range between Trendelenburg and vertical.

You wanted the spot-filming device to give you a selection of fields (whole film, half film or four "spots").

Above all, you wanted it to be easy-to-operate (motor-driven, if possible) but that seemed too much to hope for at the price you had in mind.

Well, you get all that—and much more—in this two-tube floor-mounted tubestand "Centurion" X-Ray Unit with a *motor-driven "Spotfilmer"* *and with the famous Picker built right into it.*

Your local Picker representative will be glad to tell you all about it.

PICKER X-RAY CORPORATION
25 South Broadway, White Plains, N. Y.

Picker x-ray

"Centurion" with motor-driven "Spotfilmer"

When writing please mention *Diseases of the Chest*

DISEASES *of the* CHEST

VOLUME XXII OCTOBER 1952 NUMBER 4

The Status of Tried Procedures in the Treatment of Pulmonary Tuberculosis

As Seen in the Light of Thirty Years Experience*

WILLIAM A. HUDSON, M.D., F.C.C.P. and
WILLARD B. HOWES, M.D., F.C.C.P.
Detroit, Michigan

Men of an inquisitive nature, in the last century, began to experiment with the rest idea by limiting the activity of the lung through the use of pneumothorax, but adhesions prevented the establishing of a satisfactory collapse in some cases. It was conceived and established that certain cases could be benefitted by removing segments of ribs over the diseased lung thereby permitting the lung to collapse with the closure of cavities. The regeneration of bone afforded a permanent splint for the lung in its collapsed state thereby providing enforced rest for the diseased area. Thus, by early 1920, pneumothorax and thoracoplasty had been established as means of aiding in the control of tuberculosis through rest.

Search for a chemical or other agent which would destroy tubercle bacilli and preserve the host, continued with hopes of success high at times and then waning almost to the point of disappearance. Many new surgical procedures and medicines were tried.

It seems desirable to outline the indication that lead to the use of various procedures and the present day concept of their places in the program in the light of our experience:

PNEUMOTHORAX

Yesterday	*Today*
1. Extensive progressive disease of one lung (the contralateral lung being involved but little or only soiled.	1. Moderately advanced or extensive progressive disease with cavities (not over 2 cm. in diameter.

*Presented at the 17th Annual Meeting, American College of Chest Physicians, Atlantic City, New Jersey, June 10, 1951.

Copyright, 1952, by the American College of Chest Physicians

2. Certain acute exudative lesions.
3. Cavities thin or thick walled.
4. Fibrocaseous or fibrocavernous disease confined chiefly to one lung.
5. Disease of moderate amount not showing improvement under routine sanatorium type of care.
6. To control hemoptysis.
7. To replace aspirated fluid.
8. Age, preferably not over 45 yrs.

Contraindications

a) Diabetes.
b) Draining sinuses.
c) Empyema.
d) Renal disease
e) Asthma.

2. Control of hemoptysis.
3. No age limit.

Contraindications

a) Empyema.
b) Draining sinuses.
c) Adhesions which are not suitable for section.
d) Acute exudative tuberculosis.

Yesterday, pneumothorax was a means of aiding in the closure of cavities and, because of the lack of other measures suitable for the control of the disease, many cases were started on pneumothorax and continued even though the collapse was unsatisfactory. Many developed complications such as empyema, bronchopleural fistula and ruptured cavities. In an attempt to overcome such complications, various agents and procedures were applied. Among the medications and antiseptics introduced into the pleural space were: gentian violet, methyl blue, gomenol in oil, Dakins solution, S.T. 37, azochloramide. Some cases were treated by two-way irrigation with saline solution; some had closed drainage; others, open thoracotomy.

The experience of years has demonstrated the hazards as well as the benefits to be derived from pneumothorax. Additional procedures have been devised for use in those cases deemed not suitable for pneumothorax.

PNEUMONOLYSIS

Yesterday

1. To free adhesions holding cavity open.
2. To free adhesions to allow increase in amount of collapse. Operation should be done as soon as ample space is available.

Cannot rely upon x-ray; often misleading. If patient may be benefitted, should have a thoracoscopic examination.

Today

1. When adhesions interfere with proper collapse.

Intrapleural pneumonolysis was introduced for the purpose of freeing adhesions which rendered pneumothorax ineffective because cavity was held open by the adhesions or diseased tissue was not placed at rest and subject to the strain and pull exerted by the adhesions. Extensive adhesions were successfully sectioned

and patients were apparently cured but it has been observed that the more extensive the manipulation necessary to free all adhesions, the more likely the patient is to fail to obtain the desired result and the more frequently one encounters complications of empyema, ruptured cavity, bronchopleural fistula and troublesome bleeding.

Other forms of surgery are applied in numerous cases which were formerly subjected to pneumolysis.

EXTRAPLEURAL THORACOPLASTY

Yesterday	*Today*
1. Predominently productive lesions. (Evidence of fibrosis, cavitation and atelectasis with shifting of the mediastinum).	1. Lesion of varying extent involving part of lobe or may be extensive disease.
2. Pneumothorax attempted (no free space).	2. Cavities should not exceed 3 cm. in diameter.
3. Obliterative pleuritis (during course of pneumothorax).	3. Tendency for disease to become chronic (stabilize).
4. Contralateral lung may be involved.	4. Tuberculous pleuritis.
5. Pneumothorax unsatisfactory.	5. Obliterative pleuritis.
6. Tuberculous empyema.	6. Tuberculous empyema.
7. Persistent fluid with pneumothorax.	
8. Adhesions too extensive to be sectioned.	
9. Cavities basal or elsewhere.	
10. Cavity not closed by pneumothorax.	
Contraindications	*Contraindications*
1) Age, past 45 years.	1) Bronchial obstruction.
2) Diabetes.	2) Tuberculosis, tracheal and bronchial.
3) Arterial hypertension.	3) Extensive disease with low respiratory exchange.
4) Myocardial disease.	
5) Contralateral disease.	
6) Laryngeal, gastrointestinal or genitourinary tuberculosis.	

Reduction in the volume of the hemithorax corresponding with the involved lung was looked upon as good evidence of the inherant powers of resistance and healing, as exhibited by the patients in whom such characteristic changes were present. Such patients were called good chronics. They were selected as ideal for thoracoplasty. Some failed to have their cavities closed after extensive thoracoplasty and some continued to produce tubercle bacilli in sputa. Positive sputum was frequently accompanied by spread of the disease into the other lung.

There was much discussion during the early days concerning

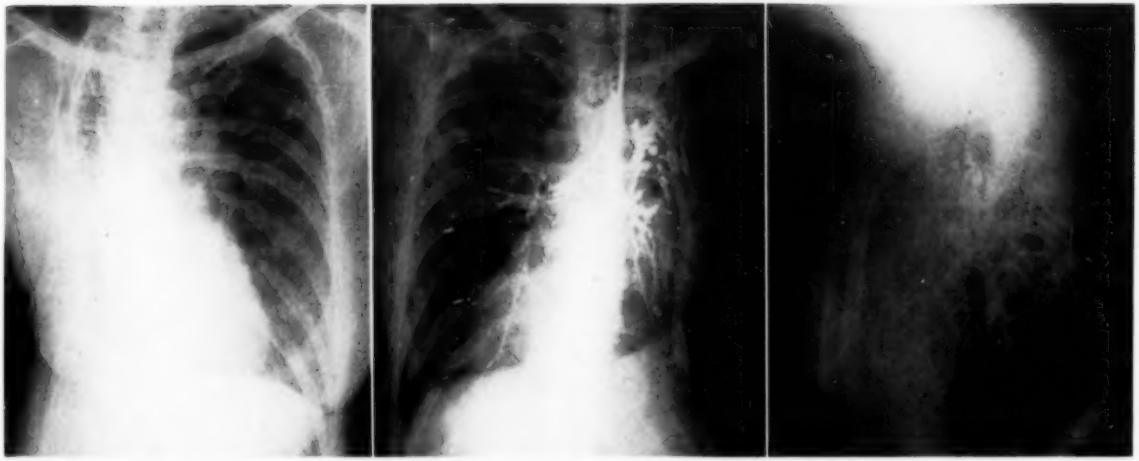


FIGURE 1: White, Female, who underwent extrapleural thoracoplasty at the age of 26 years, because of cavernous pulmonary tuberculosis with tuberculous empyema, right and extensive soiling of the left lung. X-ray and lipiodol studies 1951, after 25 years of freedom from evidence of active disease and with sputum negative for tubercle bacilli. Cough at this time due to non-tuberculous bronchiectasis. Right lung resected on January 23, 1951 with disappearance of cough and sputum; patient continues in good health at the age of 51 years.

length and number of ribs to be removed. There were those who removed long segments of all ribs on the affected side causing marked collapse of the chest wall. There were others who removed short paravertebral segments of ribs; this latter procedure was called paravertebral columnar thoracoplasty. At the same time, many argued that thoracoplasty should begin at the 11th rib and extend upward; while others said to begin with the first rib and proceed downward. Lapse of time and experience led to the general acceptance of the principle of establishing good collapse over the diseased area. The less involved portion of the lung being preserved to function.

It was also observed that basilar cavities were not generally responsive to collapse therapy. Many felt that resection of such lesions was to be preferred. Suffice it to state that in properly selected cases, thoracoplasty has proved its worth in the treatment of pulmonary tuberculosis.

The advent of antibiotics and excision has enabled the surgeon to successfully remove many lesions which were formerly treated unsuccessfully by radical thoracoplasty.

Today, the type of thoracoplasty performed is less extensive and the deformities and physical handicaps are less noticeable. This has come about through better selection of cases for thoracoplasty and the modification of surgical techniques to meet the requirements of the particular case (Figure 1).

DIAPHRAGMATIC PARALYSIS (PHRENIC)

Yesterday (usually permanent)	*Today* (usually temporary)
1. Primary procedure in exudative or productive lesions.	1. Exudative or mixed types of lesion limited to apex preferably above 1st rib.
2. Apical or mid-lung or basal lesions with or without cavity.	2. Reduce size of hemithorax during re-expansion.
3. To reduce the size of pleural space during re-expansion of lung.	3. Protective rest to cases starting exercise.
4. Preliminary to thoracoplasty.	4. To aid in control of effusion.
5. Aid in rest for the lungs in patients starting exercise.	

In the early years, paralysis of the diaphragm was usually permanent. This was accomplished either by phrenicotomy or phrenic exeresis. Additional procedures were frequently needed to complete the control of the disease. Under certain circumstances, such as contra-lateral thoracoplasty, permanent paralysis of the diaphragm became a liability. This led to a change from permanent to temporary paralysis of the diaphragm. This is obtained by crushing the phrenic nerve and sectioning of accessory branches and may be reestablished by later recrushing the nerve.

EXTRAPLEURAL PNEUMONOLYSIS

(In the presence of bilateral disease)

Yesterday	*Today*
1. Localized lesion.	1. Localized lesion.
2. Cavity, preferably not large or thick-walled.	2. Cavity not large.
3. Limited exudative lesion.	3. Limited exudative lesion.
4. Lesion above 2nd or 3rd rib anteriorly (as a rule).	4. Preferably above 2nd or 3rd rib anteriorly.
5. Preliminary to thoracoplasty in large thick-walled cavities.	
6. Secondary to thoracoplasty when cavity failed to close.	

Extrapleural pneumonolysis is a procedure which was developed for use in cases not suitable for or failing to respond to one of the other established procedures of collapse therapy. It is not uncommon for a large cavity to fail to be closed following limited or even complete thoracoplasty or for a cavity to shift in such a way as to remain open after thoracoplasty. At times, the opposite lung was diseased to such an extent that thoracoplasty was deemed unwise and extrapleural pneumonolysis found less hazardous. While indications have pointed out the fact that it is desirable to have lesion limited to the proximal portion of the lung, it must be recalled that numerous cases have been treated successfully by extrapleural pneumonolysis in other, even basal areas.

The extrapleural space has been filled with various material, in the past. Among them are, pads of fat, muscle, paraffin, oils and air. Today, we find certain plastics convenient to use and relatively free of irritation, with possibly less danger of migration of the materials or of pulmonary erosion. We have used plastic balls of various sizes, also, plastic sponges.

CAVERNOSTOMY (Cavity Drainage)

Yesterday	*Today*
1. Cavity with blocked drainage.	1. Bilateral or extensive disease with large cavity and persistent cough or complications which preclude more drastic surgical procedure.
2. Tension cavity.	
3. Bilateral disease with cavity with reduced vital capacity.	

Under the above heading may be included a number of drainage procedures such as: Monaldi suction drainage; Maurer's cavernostomy; open tube drainage and free open cavernostomy with the lining of the cavity with skin flaps. In our earlier experience, we were very much disappointed with those forms of drainage which did not result in closure of the draining bronchus before the opening in the chest wall was allowed to close. We chose, therefore, the free opening of a cavity and excision of outer wall

with placing of skin flaps to aid epithelizing the remaining portion of the cavity, thereby providing free egress of any infectious secretions which may continue to appear from the ostia of bronchi which fail to close.

More recent experiences lead us to continue this practice but to encourage closure of the bronchial opening through the destruction of bronchial epithelium by low heat, electric needle (Figure 2).

BRONCHOSCOPY

Yesterday	*Today*
1. Bronchoscopy was not considered proper.	1. To determine the condition of the bronchi in all cases considered for collapse therapy. 2. To introduce medication. 3. Differential diagnosis.
Contraindications	*Contraindications*
Not indicated.	None that are absolute.

Bronchoscopy has become one of the important elements in our diagnostic and therapeutic armanentarium. It is a means of introducing medication into the trachea and bronchi.

FIGURE 2: V.R., white, female, age 28 years, with cavernous tuberculosis right apex; exudative tuberculosis left lung. November 25, 1951, cavernostomy with skin flaps placed so as to line cavity at right apex with conversion of sputum and healing of bronchial opening. Subsequently a selective thoracoplasty August 1944, to control exudative lesion in right mid-lung field. She continues free of tubercle bacilli and is employed full time. Notice the epithelized cavern.

BRONCHOGRAPHY

Yesterday	*Today*
1. Pulmonary tuberculosis was considered a contraindication.	1. To outline bronchi to demonstrate bronchial deformity or obstruction.

Contraindications

Some say tuberculosis of itself is a contraindication, but if information is needed and the patient is not too debilitated, there are no absolute contraindications.

PNEUMOPERITONEUM

Yesterday	*Today*
1. Not generally considered until the year 1931.	1. Pulmonary tuberculosis in which unilateral or bilateral pneumothorax would be indicated but not feasible because of adhesions. 2. Exudative tuberculosis (when relaxation therapy is indicated). 3. Pulmonary hemorrhage.

Pneumoperitoneum's great value lies in the fact that relaxation of both lungs can be obtained with one procedure. Basilar lesions which do not respond favorably, as a rule, to pneumothorax or thoracoplasty are frequently greatly benefited. The danger of pleural effusion is avoided. This is especially true in cases that would otherwise require bilateral pneumothorax. Finally, even apical cavities are influenced by pneumoperitoneum. Fixation of the diaphragm may interfere with its effectiveness. The procedure is readily reversible and affords a means of testing patients who may be unsuitable for treatment by an irreversible procedure.

RESECTION

Yesterday	*Today*
1. The excision of tuberculous pulmonary tissue was looked upon as ideal procedure but was considered not practical.	1. Unilateral tuberculous lesions exudative, productive or mixed type with cavity (not suitable for thoracoplasty or pneumothorax). 2. Tuberculosis with bronchiectasis. 3. Tuberculosis with bronchial disease not responding to other therapy. 4. Tuberculosis associated with bronchial obstruction. 5. Open cavity following thoracoplasty.

Excision of the lesion eliminates the local disease with theoretically less hazard of recurring spread or reactivation of disease than other procedures. When required, collapse of the chest wall is less distressing than in primary thoracoplasty. Diaphragmatic paralysis and a limited columnar thoracoplasty is, as a rule, sufficient.

Nature's orderly pattern of anatomical and physiological relationships are disturbed less than is frequently seen following the healing of extensive lesions with or without thoracoplasty.

In excision therapy one must bear in mind that the amount of tissue to be removed must vary from case to case. Pneumonectomy, lobectomy, segmental resection (multiple or single) or wedge resection must be decided upon finally when the lung has been examined at the operating table. It can be stated that it is generally found desirable to remove more rather than less tissue than one would ordinarily anticipate from study of the x-ray films (Figures 3 and 4).

FIGURE 3: L.Mc., male, white, age 35 years. Pneumonectomy, left, on February 26, 1948 for extensive cavernous disease in left apex with extension into lower lobe. Columnar thoracoplasty, five ribs, for reduction of pleural space, with conversion of sputum. The patient returned to his regular work as an inspector; remaining in good health.

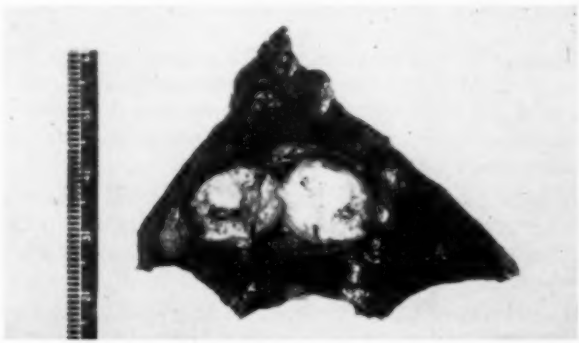


FIGURE 4: B.C., white, male, age 57 years. Lesion in left upper lobe discovered incidental to x-ray studies of chest. Segmental resection on May 27, 1948 with uneventful recovery and continued good health.

SUMMARY

1) The authors have used a multitude of procedures in the treatment of pulmonary tuberculosis. While practically all the surgical procedures have been fashionable at certain periods, each has gradually come to fit into its own particular place as the program has developed.

2) Improved and expanded diagnostic procedures have been of inestimable aid in extending the field of surgery in the treatment of pulmonary tuberculosis.

3) Improved anaesthetic and surgical techniques have not only reduced the surgical hazards but have rendered it possible to care for many types of patients who were formerly doomed.

RESUMEN

1) Los autores han usado una multitud de procedimientos en el tratamiento de la tuberculosis pulmonar. Mientras practicamente todos los procedimientos quirúrgicos han estado de moda durante ciertos periodos, cada uno ha venido a encajar en su propio lugar particular, con el desarrollo de los planes.

2) Los procedimientos corregidos y aumentados han sido de valor inestimable en la extensión del campo quirúrgico en el tratamiento de tuberculosis pulmonar.

3) Las técnicas anestésica y quirúrgica mejoradas no solo han reducido los riesgos quirúrgicos, sino también han hecho posible el cuidado de muchos tipos de pacientes que en un principio se consideraban perdidos.

RESUME

1) Les auteurs ont utilisé un grand nombre de procédés pour traiter la tuberculose pulmonaire. Comme tous les procédés chirurgicaux ont eu leur vogue à certaines périodes, a chacun d'entre eux à été progressivement attribuée sa place légitime au cours de l'évolution des méthodes thérapeutiques.

2) Le perfectionnement et l'extension des moyens de diagnostic constituèrent un appoint inestimable et permirent d'étendre le champ de la chirurgie dans le traitement de la tuberculose pulmonaire.

3) Les progrès de l'anesthésie et de la technique chirurgicale non seulement ont réduit les accidents opératoires, mais ont de plus permis d'intervenir dans des cas considérés autrefois comme désespérés.

Discussion

HENRY W. LEETCH, M.D., F.C.C.P.
Saranac Lake, New York

It has indeed been a treat to me, one who belongs to the generation of Doctors Hudson and Howes, to hear this scholarly review of the development of the treatment of tuberculosis. To relax a diseased area of the body, either temporarily with pneumothorax or phrenic nerve crush or pneumoperitoneum, or permanently with thoracoplasty, still leaves living organisms in the lung with the potentiality of causing trouble later. In the absence of a chemical cure for tuberculosis the thing to be said for collapse therapy is that it works in many cases, even though in some instances the price paid is considerable interference with the normal cardio-respiratory function.

With the use of streptomycin one can go ahead safely and increasingly with resection. This, in turn, has allowed us to study biopsy specimens of the lung as never before, and this has given us a new insight into the reason for failures in treatment and for the relapses that occur.

I will show two slides, loaned me by Doctor Medlar, which, I believe, show the basis of much present-day approach to tuberculosis. They show two lesions of about the same size, i.e. 1 x 1 cm., which look exactly alike on the x-ray film.

One shows an area of tuberculous pneumonia which has not gone on to necrosis. Medlar believes, and excisional surgery so far bears it out, that this is what disappears completely from the x-ray film after antibiotic therapy. The other shows what we used to think was healed tuberculosis, an area of necrosis which is walled in, but in which the draining bronchus of the area is not closed off but only plugged with inspissated material. If at any time the necrotic material liquefies and empties, a spread of disease may result, since Medlar has shown that bacilli are present in such areas. This, we believe, is probably the answer to the relapses in so many apparently healed cases and is a reason for resection of such an area. Naturally if even one such necrotic area can cause a relapse, a conglomeration of many such in more advanced disease is so much more dangerous.

Endobronchial Tuberculosis in Children*

JOHN F. DALY, M.D., DAVID S. BROWN, M.D.,
EDITH M. LINCOLN, M.D. and VIRGINIA N. WILKING, M.D.
New York, New York

The importance of tuberculous hilar lymph nodes in causing symptoms and signs of compression of air passages producing endobronchial lesions, obstructive pneumonitis and bronchiectasis has been discussed by others.[1-6]

A co-operative study has been undertaken by the Children's Chest Clinic and Department of Otolaryngology at Bellevue Hospital to obtain further information about the cause and course of bronchial complications of primary tuberculosis. In those patients whose x-ray films, clinical behavior and physical signs suggested bronchial obstruction, bronchoscopy was performed with the following objectives in view:

1) To discover the incidence of bronchial disease in this group and to evaluate the diagnostic methods which are available.
2) To study the course of bronchial disease by repeated bronchoscopy.
3) To correlate what was seen through the bronchoscope with x-ray and clinical pictures.
4) To evaluate available methods of therapy—both systemic and local.
5) To study the end results of the bronchial lesions: a) in themselves and b) in their effect on the distal lung segment.

Since the study has been in progress only two and one-half years, this will be a progress report on our efforts to realize these objectives.

A. *Clinical Features:*

I. *Incidence:* Four hundred and thirty-four patients with various forms of tuberculosis were seen for the first time on the Children's Ward during the two and a half year study period. In that time, 89 of these patients were examined bronchoscopically and in 43 of these (10 per cent of the entire group of patients

*From the Department of Otolaryngology of New York University Post-Graduate Medical School and the Department of Pediatrics of New York University College of Medicine and from the Otolaryngology Service and the Chest Clinic of the Children's Medical Service of Bellevue Hospital, New York City. Aided by the National Tuberculosis Association, Parke, Davis and Company and the Division of Research Grants and Fellowships of the National Institutes of Health, U. S. Public Health Service.

seen), bronchial lesions were seen, in which definite tuberculous etiology could be established. As the study progressed, the acumen of the staff in suspecting bronchial disease increased and it is noteworthy that tuberculous bronchial disease was found in 30 per cent of 90 patients seen for the first time during the last six months of the study period. This figure (30 per cent), probably represents a truer estimate of the incidence of this disease in children of this age group. One child presented the form of tuberculous endobronchial disease frequently seen in adults, which is associated with cavitation.

II. *Sex:* There was an even distribution of males and females in both the total group of children seen during the study period and in the group found to have tuberculous bronchial disease.

III. *Race:* Bronchial tuberculosis was found more commonly in non-white children. Although 27.9 per cent of all the children seen through the study period were white, only 13.9 per cent of those with proved bronchial tuberculosis were white children, as shown in Table I.

IV. *Age:* Bronchial tuberculosis was diagnosed more frequently in the younger children. Of those seen during the study period 48.4 per cent of the patients were under three years of age, but 69.8 per cent of the patients with bronchial tuberculosis were in that age group. The ages of the patients with bronchial disease ranged from four months to nine years.

V. *Stage of Tuberculosis:* Forty-two of the 43 patients in this group had primary tuberculosis diagnosed on x-ray by the presence of hilar and mediastinal lymphadenopathy. The remaining patient had chronic pulmonary tuberculosis. In five calcification was present in the hilar region and in one calcification of the parenchymal focus was present at the time the bronchial disease was discovered. Five patients had disseminated miliary tuberculosis, as well as primary disease and one had tuberculous meningitis with miliary dissemination during the early stages of his

TABLE I

Race	— — Total Group — —		Children with Bronchial Disease	
	Number	Per Cent	Number	Per Cent
Negro	144	33.2	18	41.9
Puerto Rican	165	38.0	19	44.2
White	121	27.9	6	13.9
Chinese	4	0.9	—	—
TOTAL	434		43	

bronchial disease. Definite Ghon tubercles were ultimately seen in 18 of the patients.

The signs and symptoms of endobronchial tuberculosis comprized the presenting evidence of tuberculous infection in 23 of these 43 patients. In the other 20, there was an interval of from one to 25 months, with a mean interval of seven and one-half months before the diagnosis of tuberculous bronchial disease was made in the patients with known tuberculosis.

VI. *Symptoms During the Diagnostic Period:* As noted in Table II, the most frequent symptom was persistent cough. The only symptoms which were apparently specific for an endobronchial lesion were (1) wheeze and (2) pressure cough varying from a short, high pitched expiratory bark to a paroxysmal cough. Twelve children had no symptom suggestive of bronchial disease.

VII. *Physical Signs During the Diagnostic Period:* Table III indicates that the physical signs of bronchial tuberculosis are classic

TABLE II

Symptoms in Order of Frequency

Persistent, dry cough for 2 or more weeks	18 Instances
Brassy or paroxysmal cough	14 Instances
Wheezing	8 Instances
Fever	7 Instances
Repeated pneumonias in the past	5 Instances
Pertussis—just prior to discovery of bronchial tuberculosis	2 Instances

TABLE III

Physical Signs in Order of Frequency

Diminished breath sounds	36 Instances
Dullness	31 Instances
Persistent wheeze	12 Instances
Rales	9 Instances
Diminished thoracic motility on respiration	6 Instances
Bronchial breath sounds	5 Instances
Deviation of mediastinum (cardiac dullness)	4 Instances
Hyper-resonance	3 Instances
Tracheal shift	2 Instances
Diminished tactile fremitus	2 Instances
Diminished vocal fremitus	2 Instances

Three patients presented no physical signs.

findings expected in any case of bronchial obstruction, regardless of cause.

VIII. *X-ray Features During the Diagnostic Period:* Excluding the one case with chronic pulmonary tuberculosis, the 42 patients with primary tuberculosis showed hilar or mediastinal node enlargement on x-ray films. Thirty-seven of the 42 showed dense, homogeneous shadows involving lobes or segments and the remaining five showed emphysema of an entire lung without parenchymal shadows, other than the probable infiltrate of the primary infection. Of the 37 with lobar or segmental shadows, it was possible to diagnose bronchial obstruction from x-ray films alone in 26, because of significant displacement of one or more of the interlobar fissures. It is noteworthy that these radiographic abnormalities were found in the right lung far more frequently than they were in the left. They were noted on the right side in 33 cases and on the left side in 10. The lobe most frequently involved was the right middle (14 instances), and the next most frequently involved was the right upper (12 instances). Every lobe and segment was involved at least once in this series.

Thirteen cases displayed deviation of the mediastinum and seven showed abnormal elevation or depression of one of the diaphragmatic leaflets. Fluoroscopy was useful in confirming impressions gained from x-ray films and in observing the intrathoracic dynamic changes associated with bronchial obstruction. Diaphragmatic limitation and displacement, mediastinal shift and splinting of the involved chest were noted, but in no case did fluoroscopy alter diagnostic impressions gained from careful physical examination and study of the x-ray films.

B. *Bronchoscopic Aspects of the Disease:*

I. *Procedure:* Eighty-nine patients were examined bronchoscopically during the two and one-half year study period. Since most of these children were examined repeatedly, more than 230 separate bronchoscopic procedures were performed.

Satisfactory bronchoscopy could be accomplished only with the use of a general anesthetic because careful inspection was necessary. A method was developed, which in our experience, has been safe, free of trauma and has produced no serious complications. However, a word of caution should be expressed concerning the development of spasm and apnea, which may present a distressing problem to one not familiar with this type of anesthesia. In two children a period of prolonged apnea occurred, which was successfully managed by intubation with the bronchoscope and delivery of oxygen through the ether cannula of the scope.

The study required a careful inspection of the entire tracheo-

bronchial tree and an accounting of every segmental division visible through the bronchoscope. To accomplish this in a struggling unanesthetized child of a few months to nine years of age, would be physically impossible, not to say quite inaccurate. The psychic trauma of such a procedure would make repeat bronchoscopies undesirable and probably unobtainable. We are also convinced that the struggling done by the child while the scope is in place plus coughing and crying accounts for the trauma to the larynx, with resulting subglottic edema. These considerations made it highly desirable to develop a general anesthesia technique. In this we had the cooperation of Doctor Rovenstine and his staff.

Sodium surital (sodium 5-allyl-5 [1-methylbutyl]-2-thiobarbiturate) was used rectally in 1 gram dose per 50 pounds of body weight in a 2 per cent solution. The details of this technique have been published.[7] The dangers of bronchospasm and laryngeal spasm were controlled to a great degree by preliminary anesthesia of the tracheo-bronchial tree accomplished by aerosolizing 8 cc. of 0.5 pontocaine solution containing a wetting agent.[8]

A 3.5 mm. bronchoscope, for children younger than 24 months, and a 4 mm. instrument for those from two to five years of age was used. The complete relaxation of the child during bronchoscopy made it possible to inspect carefully the orifices of all the important bronchi and obtain specimens and biopsies. Such relaxation also eliminated the trauma due to struggling of an unanesthetized child. As many as 15 children were done in a four hour period. Bronchoscopy was not done if the child had an acute upper respiratory infection, laryngitis, or if the anesthesia was unsatisfactory. A simple test for the effectiveness of the anesthesia was the child's reaction to painful stimulus, e.g., pinching the skin of the pectoral region. If the child slowly flexed its arm and leg on the same side—anesthesia was considered satisfactory. If the child did not move, anesthesia was too deep and the likelihood that annoying laryngeal and bronchial spasm would develop was greater. If the child cried or moved about, the anesthesia was considered too light and satisfactory examination could not be done because of the activity during bronchoscopy.

II. *Criteria for First Bronchoscopic Examination:* When any one of the following findings was present in a child with a positive mantoux, it was felt that bronchoscopic examination for bronchial tuberculosis was indicated.

1) Persistent respiratory wheeze.
2) Localized emphysema on x-ray film inspection.
3) Brassy cough.
4) Persistent dry cough, even in the absence of significant lung shadows on x-ray film.

5) Sudden increase in the x-ray shadow around or near a previously stable primary focus.
6) An x-ray shadow suggesting obstruction of a lobe or pulmonary segment.
7) Persistently positive gastrics in a child without significant findings on x-ray or physical examination.

III. *Criteria for Repeated Bronchoscopies:* Visualization of the bronchial lesion is important in evaluating the effectiveness of therapy. Repeated examinations are therefore required. In addition, lesions were frequently not seen until the third or fourth examination. With the psychic and physical trauma from the procedure controlled by a safe general anesthesia, repeated examinations were possible in this study. Intervals between bronchoscopies usually varied from one to six months.

Appearance of Lesion on Initial Bronchoscopy

a) *Bronchial compression or fixation by nodes:*

	No. of Cases
Bronchial fixation only	1
Bronchial fixation and compression	1
Bronchial fixation and compression with mucosal inflammation	3

b) *Bronchial obstruction:*

By mucosal inflammation	24
By granuloma	11
By caseous material from ruptured node	1
By fibrous stricture	1

Although follow-up in these 42 patients has been insufficient to determine whether or not the disease process has completely subsided, enough patients have been watched to the point of quiescence to permit the observers to outline a pattern of progression which these lesions seem to follow in the course of healing. The earliest stage of the disease which could be recognized through a bronchoscope was mostly extra-bronchial; the bronchus was fixed or compressed by enlarged nodes, but did not display any irregularity of the endobronchial mucosa. The next stage seemed to be the result of mucosal irritation producing diffuse inflammation and edema. In the third stage mucosal edema and inflammation was replaced by granulation. In 10 out of 11 cases we were able to observe progression from an inflamed and edematous reaction to a granular mucosa. During this transition from the first to the second stage, we observed actual perforation of an extrabronchial caseous mass through the bronchial wall in two of the cases who initially displayed compression of the bronchus at the site of the subsequent perforation. A third case showed an

unchanging granular mucosa for four months at the site of his eventual perforation.

We have observed four subsequent developments from the stage of mucosal granulation: 1) One patient was seen to perforate and drain an extrabronchial caseous mass through a bronchial sinus. 2) In two patients, mucosal granulations were observed to clear, leaving bronchial lumina stenosed by fibrotic scar. 3) The endobronchial granulations cleared in an average of six months in 14 patients, leaving normal bronchial mucosa. 4) In 10 patients the mucosal granulations became exuberant, rising in irregularly distributed mounds and plaques and ultimately coalescing into solitary pedunculated granulomata. This last development took place in an average time of three months from the time the mucosa was first noted to be granular. Since, in addition to these 10 patients, who displayed pedunculated granulomata, 11 others were found to have lesions of this type when they were first examined, we believe that the pedunculated granuloma is the most typical and most frequently found form of this disease. Eleven patients with endobronchial polyps have gone on to complete clearing in an average time of seven months from the time of visualization of the polyp and two patients developed fibrotic stricture of the bronchus at the site of such lesions. These pedunculated masses have persisted for more than a year in four patients and in three have recurred after being removed mechanically through the bronchoscope. One recurred within two months on the base which was left by a similar mass which was coughed out during the bronchoscopic examination.

c) *Duration of the Lesions:* Arrest of the endobronchial lesion occurred in an average period of 8.4 months from the time the lesion was first observed, with the range of duration extending from two and one-half to 32 months. In evaluating the approximate duration of these lesions, it is well to keep in mind that the interval between the actual appearance of the lesion and the time it developed proportions sufficient to produce signs and symptoms is unknown in each case and also that varying forms of treatment were used.

d) *Pathology of the Lesions:* In six cases granulomata were examined microscopically. All six of these specimens showed tuberculous granulation tissue with Langhans giant cells, tubercles and caseation necrosis. One such mass, which had been present for 26 months showed extensive calcification. It is noteworthy that only one of these biopsies showed acid fast organisms on Ziehl-Neelsen stain. A specimen of the cheesy material obtained from a sinus through a bronchial wall showed caseation necrosis on section and tubercle bacilli were cultured from it.

e) *Bacteriology of the Lesions:* Thirty-four of the patients in this series of 42 had positive cultures from gastric washings sometime during their course. Nineteen were found to have bronchial secretions which were positive on culture and all but one of these had previously had at least one or more positive gastrics.

f) *Location of the Lesions:* Fifty-two different lesions were observed in this group; nine patients had two or more separate lesions simultaneously. In addition, several had lesions (always pedunculated granulomata) which migrated from lobar bronchi into the major stem bronchi. Four had lesions which recurred. On initial examination, the distribution in the tracheo-bronchial tree of these lesions is seen in Table IV.

IV. *Late Manifestations of Endobronchial Tuberculosis in Children:* Continued observations will be necessary before conclusions about the complications of bronchial involvement in primary tuberculosis can be made with any accuracy, but our present information gives some definite impressions.

Bronchiectasis may be a frequent consequence of the bronchial obstruction seen in these patients. Five children have already been found to have bronchiectasis proved by bronchograms in the lobes which were previously obstructed. Eighteen patients have persistent x-ray shadows, productive coughs, rales over previously obstructed lung areas and episodes of pulmonary infection with fever and leukocytosis, which respond readily to antibiotics and suggest the diagnosis of bronchiectasis, although this possibility has not yet been explored with lipiodol studies. In 14 patients the clinical evidence for bronchiectasis is equivocal, but in only six out of the 42 studied is clinical evidence for this possibility entirely lacking. It is planned to obtain lipiodol studies on all 42 of these patients before the study is completed.

It is of interest to note that of the 12 patients who had obstruction of the lung segment which contained the primary tuberculous focus, two have been found to have bronchiectasis in the

TABLE VI

Location of Lesions

Right	Instances	Left	Instances
Upper lobe bronchus	10	Main bronchus	11
Middle lobe bronchus	10	Upper lobe bronchus	2
Main bronchus	9	Lower lobe bronchus	1
Lower lobe bronchus	5	Lower lobe—	
Lower lobe—		Dors. Seg. bronchus	1
Apical Seg. bronchus	3		
TOTAL	37		15

same lobe, eight have strong clinical evidence pointing to bronchiectasis and in only two is the possibility of bronchiectasis unlikely. The remaining five with definite parenchymal primaries had obstruction which was manifest by emphysema rather than by absorption collapse and these five have no evidence of bronchiectasis.

V. *Treatment:* In addition to rest in bed and an adequate diet, 39 children in this group of 42 had specific therapy with streptomycin or dihydrostreptomycin alone or in conjunction with para-aminosalicylic acid or promizole. In 34 of these it was possible to study bronchoscopically the effect of 36 seperate courses of therapy. There was no control group. No drug was used for courses shorter than 42 days, and when streptomycin or dihydrostreptomycin was used, it was in daily doses, never less than 0.5 grams; para-aminosalicylic acid was used in amounts sufficient to produce blood levels of 3 mgm. per cent and over, and the dose

TABLE V

Type of Treatment and Course of Disease

	Improvement 3 months after start of treatment	No improvement within 3 months after start of treatment	Disease worse within 3 months after start of treatment
SM or DHSM	6		1
DHSM		1	
SM and Para-amino-salicylic acid	3	1	
DHSM and Para-amino-salicylic acid	5	1	1
SM and Promizole	2	3	1
DHSM and Promizole	3	4	2
SM, Para-amino-salicylic acid, Promizole	1		
Para-amino-salicylic acid alone	1		
Forceps removal	2	1	
Dilatation		1	
$AgNO_3$		3	
Suction	2		

Each unit recorded indicates one course of chemotherapy or one trial of the local therapeutic measure.

Three patients in the group of 42 were not treated; five were not observed bronchoscopically during their treatment.

of promizole was regulated to produce blood levels between 1 and 3 mgm. per cent.

In contrast to the patient with chronic pulmonary disease where streptomycin produced complete clearing of the shallow ulcers and widespread inflammation of the bronchial mucosa within three weeks, the best result obtained in the 20 patients who showed improvement within 90 days after the beginning of treatment, was moderate reduction in the degree of obstruction produced by the lesion. Details of treatment and results are shown in Table V. Variation in the amount and duration of therapy and the small size of the groups treated, make comparison of the effectiveness of the various types of chemotherapy impossible, but in the cases who improved, we have been able to make some

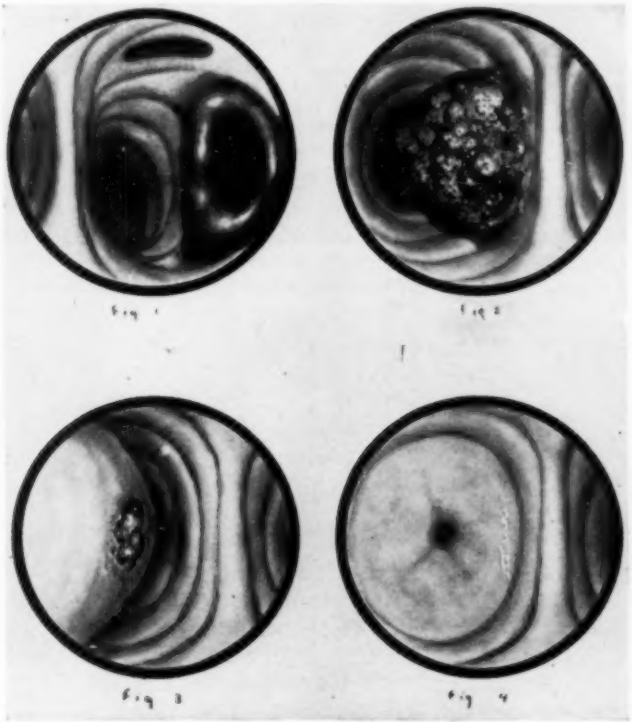


Figure 1: Early endobronchial tuberculosis of right upper lobe bronchus. *Figure 2:* Tuberculoma of medial wall of left main bronchus.—*Figure 3:* Compression with ulceration and fistula formation of left main bronchus. *Figure 4:* Stenosis of left main bronchus above opening of left upper lobe.

observations about the type of lesion which might respond to chemotherapy. Twenty courses of therapy with streptomycin or dihydrostreptomycin were given, during which improvement was noted in the bronchoscopic appearance of the lesion. In 13 of these the lesion before treatment was simple granulation of the mucosa, in three the lesion was inflammation and edema of the mucosa, in two there was visible compression of the bronchial wall with edema and inflammation of the overlying mucosa and in two the pre-treatment lesions were pedunculated granuloma. All of these lesions became less within three months of the beginning of streptomycin or dihydrostreptomycin treatment. There were 14 courses of similar treatment given in which there was no improvement and progression of the lesion in three. Nine of the lesions so treated were pedunculated granulomata, three consisted of heavy granulation tissue and in two only, inflammation and edema of the bronchial mucosa were visualized.

Penicillin, sulfa compounds, aureomycin and chloromycetin were used frequently when evidence of suppuration distal to obstructive lesions was present and in the presence of respiratory infections in these children. Because there was no way of establishing a control series, it is impossible to evaluate the effect of these measures in reducing the incidence and severity of such infections.

The use of local therapy directed to the lesion was not considered feasible. Topical application of antibiotics could not be used effectively. Use of silver nitrate was made difficult by obvious

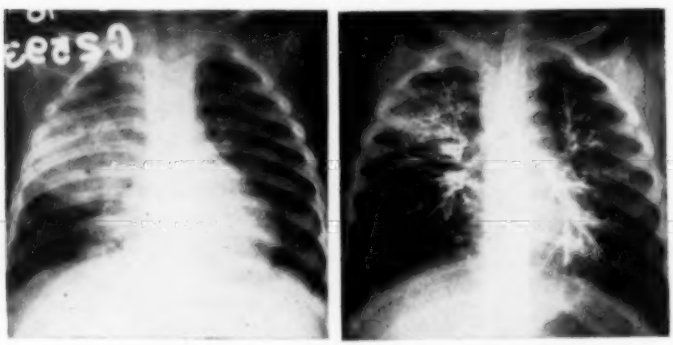


FIGURE 5a FIGURE 5b

Figure 5, Case 1: (a) X-ray of February 16, 1948 showing widening of mediastinum to right, diffuse clouding from 4th to 8th posterior ribs. Irregular clouding adjacent to right heart shadow interpreted as possible bronchogenic spread.—(b) Bronchogram of March 13, 1950 showing narrowing of bronchus to right middle lobe and distortion and incomplete filling of middle lobe bronchi.

mechanical problems inherent in small scopes, small bronchi and respiratory movement of bronchi. Most successful has been the surgical removal of pedunculated granulomas by forceps, scope tip or aspirator.

Illustrative Case Records

Case 1: E.C., an 11 month old Puerto Rican boy was admitted in February 1948 because of brassy cough, fever and a positive patch test. A wheeze was present and x-ray film showed homogeneous shadow in left upper lobe (Figure 5a). Bronchoscopy revealed only hyperemia of the tracheo bronchial tree; culture of bronchial aspiration positive for tubercle bacilli. Cough and mild respiratory distress continued. Repeat

FIGURE 6a FIGURE 6b

FIGURE 6c FIGURE 6d

Figure 6, Case 2: (a) X-ray of September 1, 1949 showing marked rounded enlargement in region of right hilum.—(b) X-ray of October 19, 1949 showing widening of mediastinum to right and homogeneous clouding from 7th to 9th right posterior ribs.—(c) X-ray of January 4, 1950 showing new shadow similar to x-ray of October 19, 1949 but sharply demarcated above. Mediastinum still enlarged to right. Lateral view (d) shows clouding localized in right middle lobe; shadow in retrocardiac space interpreted as residual involvement of anterior basilar segment of right lower lobe.

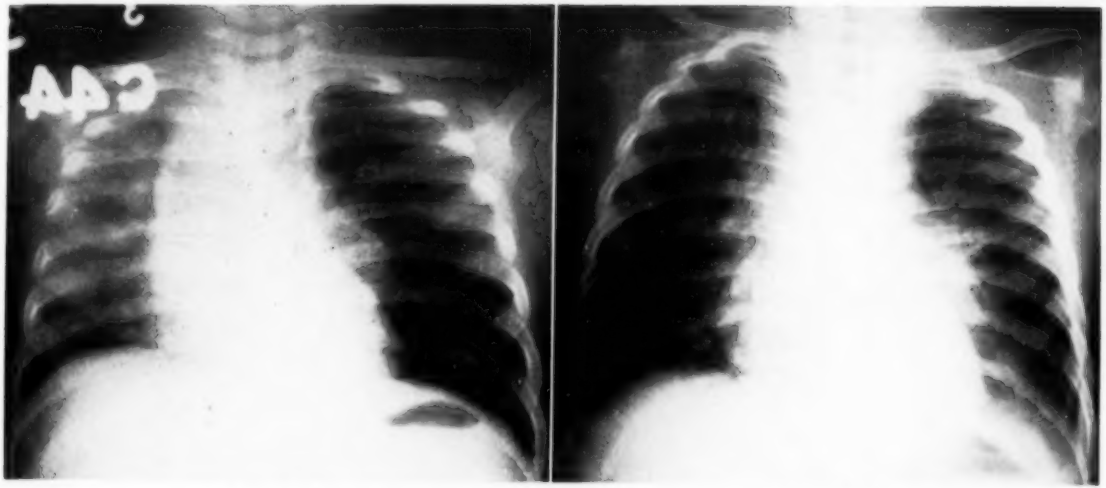


FIGURE 7a FIGURE 7b

Figure 7, Case 3: (a) X-ray of March 3, 1950 shows markedly increased density in left chest with rounded enlargement in left root. Deviation of mediastinum to right.—(b) P.A. view of April 10, 1950 shows rounded enlargement of upper mediastinum to right with less evidence of emphysema. Homogeneous shadow above left diaphragm with obliteration of left costophrenic angle; shadow continuing along left heart border to root sharply demarcated above by concave line. (Case 3 cont. to Figs. 7c, d and e).

bronchoscopy in May showed extensive granulation tissue on the medial wall of the right middle lobe bronchus. Patient treated for 42 days with 0.5 gm. streptomycin daily. Bronchoscopy in July showed compression of right main bronchus and tuberculous granulation tissue involving orifice of right upper lobe bronchus; bronchoscopy in September showed tuberculous granulation tissue as before, but no evidence of compression; brassy cough continued with persistence of x-ray shadow. Bronchoscopy in December showed narrowing of lumen of right main bronchus due to granulation tissue. Symptoms disappeared by February 1949. Bronchoscopy in June 1949 showed no granulation tissue, but stenosis of right upper lobe bronchus. Bronchogram (Figure 5b), July 1950 showed stricture of right middle lobe bronchus and minimal bronchiectasis of right middle lobe.

Case 2: R.H., a five year old Negro boy admitted August 31, 1949 with poliomyelitis. Tuberculin was positive and chest x-ray film (Figure 6a) interpreted as primary tuberculosis. X-ray film of Oct. 19, 1949 (Figure 6b) showed shadow in right lower lung field which decreased in size by November 14, 1949, but could still be seen on x-ray film of December 9, 1949. Bronchoscopy of December 1, 1949 showed anterior and middle basal segmental bronchi of right lower lobe obstructed with edematous tissue with purulent exudate coming from lateral segmental bronchus. X-ray film of January 4, 1950 (Figure 6c and 6d) showed new area of clouding in right middle lobe. Bronchoscopy showed a polyp arising in the right lower lobe bronchus; thickening of mucosa around orifice of right middle lobe bronchus. Dihydrostreptomycin 0.5 gm. and para-aminosalicylic acid given daily from January 21, 1950 through March 7, 1950 and para-aminosalicylic acid continued until July 5, 1950. Rapid shrinking of x-ray shadow in right middle lobe last seen in lateral view on February 1, 1950. Bronchoscopies in February and March showed decrease in size of granuloma in right lower lobe bronchus, but definite granulation tissue partially occluding right middle lobe orifice. Bronchoscopy on June 8, 1950 showed hyperemia of right middle lobe bronchus. Only slight thickening of right middle lobe orifice noted on follow-up bronchoscopy March 22, 1951.

Case 3: R.B., a 10 month old Negro boy admitted March 2, 1950 with a five month history of cough and enlarged cervical nodes. Brassy cough and wheeze on admission which persisted. X-ray film (Figure 7a) showed shift of mediastinum to right, emphysema on left and enlarged left root shadow. Bronchoscopy April 6, 1950 showed indentation of lateral tracheal wall above carina on left with normal mucosa. X-ray films of April 10, 1950 (Figures 7b and 7c) showed a shadow of left lower lobe collapse on oblique view not seen on posterior anterior view. A brassy cough persisted. At the end of May the child became acutely ill with fever. X-ray film of May 31, 1950 (Figure 7d) showed shadow in left upper lobe interpreted as bronchogenic spread. Streptomycin 1.0 gm. and promizole daily begun June 2, 1950. Bronchoscopy June 8, 1950 showed extension of caseous material through a mass of granulation tissue on lateral wall of left main bronchus apparently due to rupture of a tuberculous node with fistula formation into the bronchus. Because of poor clinical condition, para-aminosalicylic acid was added to therapy June 17, 1950. Steady clinical improvement July and August. Bronchoscopy unchanged on June 29, 1950, on August 10, 1950 showed large polypoid

FIGURE 7c FIGURE 7d FIGURE 7e

Figure 7, Case 3 (continued): (c) On Oblique view the emphysema in the left lung is well visualized; sharply demarcated shadow interpreted as collapse of left lower lobe.—(d) May 31, 1950 shows extension of clouding into left upper lobe.—(e) February 21, 1951 shows only slight deviation of heart and mediastinum to right with bilateral triangular homogeneous shadow extending outward from mediastinum opposite tips of first anterior ribs interpreted as mediastinal pleural shadows.

granulating mass occluding left main bronchus, but moving to and fro with respiration; 60 per cent of this was removed with forceps. By end of August x-ray film showed marked clearing of left upper lobe and mediastinum in normal position and absence of emphysema on left. Bronchoscopies at monthly intervals showed steady improvement, however, new granuloma was noted on the medial wall of the left middle bronchus on September 7, 1950 with some edema of the right main bronchus. Further improvement on x-ray film and bronchoscopy from October to February 1951, with complete clearing of left upper lobe lesion. Follow-up bronchoscopy February 1, 1951 showed polypoid mass of granulation tissue on medial wall of left main bronchus with a small amount of granulation tissue in left upper lobe bronchus. X-ray film of February 21, 1951 (Figure 7e) is clear except for slight deviation of mediastinum to left and bilateral apical shadows continuous with mediastinum.

SUMMARY

The endoscopic findings in a series of cases of endobronchitis associated with primary tuberculosis are presented to emphasize their importance in diagnosis and prognosis.

Forty-three children with endobronchial disease were observed. The one case associated with reinfection pulmonary tuberculosis responded promptly to streptomycin therapy. In the remaining 42 cases, where the endobronchial disease was associated with primary pulmonary tuberculosis, no definite evidence of the effective use of streptomycin therapy was obtained.

The most common symptom suggesting endobronchial disease was persistent cough, sometimes paroxsymal or brassy in character. Wheezing was a complaint in one-fourth of the cases. More than one-quarter of the cases had no symptoms suggesting tuberculous involvement of the bronchi. Dullness and diminished breath sounds over a localized pulmonic area were the most common physical signs. A persistent wheeze was heard in about one-third of the patients.

X-ray films of 37 of the 42 patients showed homogeneous shadows involving lobes or segments and the other five showed obstructive emphysema.

Bronchoscopy could be done safely and repeatedly because of a new technique of anesthesia with surital and local pontocaine.

Criteria for bronchoscopy in children with primary pulmonary tuberculosis were cough, wheeze, sudden increase in x-ray shadows around a previously stable primary focus, an x-ray shadow suggesting obstruction or obstructive emphysema or a report of persistently positive cultures from gastric washings in a child without significant findings on x-ray film or physical examination.

A pattern of the pathogenesis of endobronchial disease asso-

ciated with primary tuberculosis emerges as a result of repeated bronchoscopies; bronchial compression without mucosal involvement may precede endobronchial disease. Edema and inflammation may precede ulceration and granulation; erosion of the bronchial wall may follow; caseous polyps may develop and ultimately stenosis of a bronchus.

Bronchiectasis has already been proved by bronchogram in five of the 42 cases and is suspected in 18 more.

RESUMEN

Los hallazgos endobrónquicos en una serie de casos endobronquitis asociada a tuberculosis primaria, se presentan para enfatizar su importancia en diagnóstico y pronóstico.

Cuarenta y tres niños con enfermedad endobronquial se obseevaron.

El caso asociado con tuberculosis pulmonar de reinfección, respondió prontamente a la estreptomicina. En los otros 42 casos, en los que la afección endobronquial se asoció a la tuberculosis primaria, no hubo evidencia definida de que fuese efectiva la estreptomicina.

El síntoma más común sugerente de enfermedad endobronquial, fué la tos persistente, a veces paroxística y sonora.

La sibilancia fué un síntoma en un cuarto de los casos. Más de un cuarto de los casos no tenían síntomas que sugirieran el compromiso tuberculoso de los bronquios. Los signos físicos más comunes fueron obscuridad y ruidos respiratorios disminuidos sobre una area limitada del pulmón. Un silbido persistente fué percibido en un tercio, aproximadamente, de los enfermos.

A los rayos X se encontraron manchas homogeneas en areas correspondientes a lóbulos o segmentos de 37 enfermos entre 42, y otros cinco mostraban enfisema obstructivo.

La broncoscopia pudo hacerse segura y repetidamente, mediante una nueva técnica de anestesia, con surital y pantocaína local.

El criterio para la broncoscopia en los niños con tuberculosis primaria, fué decidido por la presencia de tos, silbidos bronquiales, repetino aumento de una mancha a los rayos X, alrededor de un foco primario antes estable, un aspecto a los rayos X sugiriendo obstrucción o enfiesema obstructivo, o un informe de cultivos de contenido gástrico persistentemente positivo en un niño sin hallazgos significantes a los rayos X o al examen físico.

Como resultado de repetidas broncoscopias, emerge un patrón de lapatogenia de la enfermedad endobronquial asociada con tuberculosis primaria; compresión bronquial sin invasión de la mu-

cosa puéde preceder a la ulceración y a la granulación; puede seguir después la erosión de la pared bronquial y desarrollarse pólipos caseosos. Por último vendrá la estenosis del bronquio.

La bronquiectasia se ha demostrado ya por el broncograma en 5 de 42 casos y se sospecha en 18 más.

RESUME

Les auteurs rapportent leurs constatations endoscopiques dans une série d'observations d'atteintes bronchiques associées à la tuberculose de primo-infection. Ils insistent sur leur importance au point de vue du diagnostic et du pronostic.

Ils ont observé quarante trois enfants atteints de localisations bronchiques. L'unique cas auquel un type de réinfection s'ajoutait fut rapidement traité grâce à la streptomycine. Dans les quarante-deux autres cas pour lesquels l'atteinte bronchique était associée avec une tuberculose primarie, l'utilisation de la streptomycine ne montra aucune efficacité certaine.

Le symptôme le plus habituel qui fit suspecter l'atteinte bronchique fut la toux persistante, parfois à type paroxystique. Dans un quart des cas, o constata l'existence d'un "wheezing." Plus d'un quart des malades ne présentaient aucun symptôme pouvant faire suspecter l'atteinte tuberculeuse de l'arbre bronchique. L'obscurité et la diminution du bruit respiratoire dans une zone pulmonaire localisée furent les signes physiques les plus fréquents. Un sifflement persistant fut perçu chez un tiers environ des malades.

Chez 37 des 42 malades, les radiographies montrérent des ombres homogènes, occupant les lobes ou les segments. Les cinq autres malades avaient des signes d'emphysème obstructif.

Les auteurs purent pratiquer leurs bronchoscopies sans ennuis, et de façon répétée, grâce à leur nouvelle technique d'anesthésie.

Les indications de la bronchoscopie chez les enfants atteints de primo-infection tuberculeuse furent la toux, le sifflement bronchique, l'accroissement soudain des ombres radiologiques autour d'un foyer primarie jusqu'alors stable, une ombre radiologique évoquant une obstruction ou un emphysème obstructif, ou bien l'existence de cultures positives persistantes sur les tubages gastriques malgré l'absence de constatations radiologiques pouvant les expliquer.

La pathogénie de l'atteinte bronchique associée à la primo-infection se dessine grâce aux bronchoscopies répétées. La compression bronchique sans atteinte de la muqueuse peut précéder la localisation tuberculeuse endo-bronchique. L'oedème et l'inflammation peuvent précéder les ulcérations et les granulations. Il peut en résulter une ulcération de la paroi bronchique. Il peut se

développer des masses tumorales caséeuses et finalement une sténose de la bronche.

L'existence de bronchiectasies a été prouvée par bronchographie dans cinq des quarante-deux cas, et a été suspectée dans dix-huit autres.

REFERENCES

1 Macpherson, A. M. and Lutwyche, V. U.: "Collapse of the Lung Associated with Primary Tuberculous Lesions," *Thorax*, 5:1, 1950.

2 Richards, W. F.: "Bronchial Obstruction in Primary Pulmonary Tuberculosis," *Proc. R. Soc. Med.*, 37:589, 1944.

3 Jones, E. M., Rafferty, T. N. and Willis, H. S.: "Primary Tuberculosis Complicated by Bronchial Tuberculosis with Atelectasis (Epituberculosis)," *Am. Rev. Tuberc.*, 46:382, 1942.

4 Hutchinson, J. E.: "The Pathogenesis of Epituberculosis in Children, with a Note on Obstructive Emphysema," *Glasgow Med. J.*, 30:271, 1949.

5 Roberts, J. C. and Blair, L. G.: "Bronchiectasis in Primary Tuberculosis Associated with Segmental Collapse," *Lancet*, 258:386, 1950.

6 Jones, E. M., Peck, W. M. and Willis, H. S.: "Bronchiectasis Following Primary Tuberculosis," *Am. J. Dis. Child.*, 72:296, 1946.

7 Helrich, M., Daly, J. F. and Rovenstine, E. A.: "Anesthetic Management of Infants and Children During Endoscopy," *Ped.*, 6:625, 1950.

8 Miller, J. B., Mann, F. and Abramson, H. A.: "A Method for Topical Anesthesia by Nebulization of Local Anesthetics," *Dis. of Chest*, 16: 408, 1949.

A Case of Multiple Pulmonary Infarctions Occurring in an Ambulant Male, and Associated with Rectal Lesions*

DANIEL J. STONE, M.D.† and FRANCIS J. LOVELOCK, M.D.††
Bronx, New York

The problem of pulmonary embolism with infarction continues to fascinate the pathologist and clinician alike. With the advent of the pioneer work of Homans,[1] Allen[2] and others.[3-5] The emphasis, and rightly so, has been on the dangers of deep vein thromboses, particularly in the calf, femoral and iliac areas. Its relationship in the debilitated, the surgical and cardiac patient, to pulmonary artery embolization is too well documented to require discussion.

Less well publicized, are the occasional cases of pulmonary infarction, occurring in ambulant and apparently well individuals. Except for one or two scattered case reports, this has received little attention. The rectum and its venous drainage as a possible source of pulmonary emboli has been mentioned as such in only one relatively recent study.[6]

It is the purpose of this paper to discuss the problem of the rectum as a source of embolization and to report a case which suggests that possibility.

A 33-year old Negro male was admitted on January 2, 1948 for pleuritic pain (in the right side of the chest) of one month's duration. He had no symptom of pulmonary disease prior to October 1945, when he developed an acute attack of fever and wheezing while on Saipan. A diagnosis of bronchial asthma was made, and he was discharged in January 1946. He continued to have mild bouts of asthma, occurring every two or three months, which were treated symptomatically, and were never associated with cough or sputum.

The present illness began suddenly on December 2, 1947, with malaise, fever and severe chest pain localized in the area of the right nipple, axillary and scapular regions. The pain was knife-like in character and aggravated by the slightest respiratory movement. Shortly after onset,

---

*From the Medical Service of the Veterans Administration Hospital, Bronx, New York. Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

†Assistant Chief, Chest Medical Section.
††Chief, Chest Medical Section.

four to five teaspoonfulls of bright red blood was expectorated. On December 5 he was admitted to another hospital. A diagnosis of pneumonia was made, and he was treated with penicillin, becoming symptom-free and afebrile over a 10-day period. On the 20th of December, five days after ambulation had been started, the same symptom-complex recurred with pleuritic pain in the right lower chest and with x-ray evidence of a pleural reaction at the right base. He was retreated with penicillin for a seven-day period and was discharged from the hospital, symptom-free on December 30, 1947. He was admitted here on the second of January 1948 merely for a check-up examination.

Past history included bleeding internal hemorrhoids operated on in 1942 and 1944. One year prior to admission he had a spontaneous discharge of pus from the rectum. Five months before admission he noted occasional serosanguinous discharge from the rectum and pain unrelated to defecation. He was treated for a chancre in 1939, and retreated in 1944 because of positive serology.

On admission to this hospital his temperature was 99.9 degrees F., pulse 90, and respiration 20. He was a thin, asthenic Negro not appearing acutely ill, but somewhat malnourished and fatigued. There was right lower dorsal scoliosis. Over the right lower lobe there was dullness, diminished fremitus and breath sounds and post-tussic fine rales. Blood pressure was normal and cardiac examination was negative. Peripheral arterial pulsations were all normal. No edema, discoloration or heat was noted in the lower extremities. Homans' sign and calf tenderness were absent. The liver edge was palpable just beneath the costal margin, and was firm and non-tender. Rectal examination revealed a ring of tender external hemorrhoidal tags. Above the sphincter, several observers noted a roughened and somewhat nodular area on the posterior surface of the rectum, which was slightly tender. No rectal discharge was noted on admission. The remainder of the physical examination was within normal limits.

Sedimentation rate was 23 mm./hr. (Cutler method). A Kahn titre of less than 10 units was reported. X-ray films and fluoroscopy revealed a rather dense pleuritic reaction at the right base posteriorly with a mottled infiltrate in the same area. An old ununited fracture of the axilliary segment of the right, fifth rib was noted.

Four days after admission (on January 6, 1948) he developed severe left pleuritic chest pain requiring administration of codeine. Physical examination revealed suppression of breath and voice sounds in the left axilla. He was apprehensive, with pulse rate of 100 and normal temperature. With the onset of this episode, dark bloody sputum, mixed with small clots was noted and he continued to raise small amounts of dark red blood and rusty sputum for the next four or five days. Chest x-ray film, including oblique projection revealed in addition to the previous findings, a small pleural effusion at the left base and a definite circumscribed parenchymal infiltrate in the base of the left lung (Figure 1). A careful re-examination of the peripheral veins was negative. Because of the previous rectal findings, re-examination was done and the previously noted ragged area just above the sphincter was now exquisitely tender. A cord-like projection was felt on the posterior wall of the rectum in the same area. Temperature became elevated and varied around 102 degrees F. for the next four days.

It was felt that the evidence was sufficient for a diagnosis of multiple

pulmonary emboli with infarction and the patient was treated with anticoagulants. Penicillin was added because of the rectal inflammation. The white blood count was 11,400 with moderate polynucleosis. Liver chemistry was normal except for a transient elevation of the icterus index to 16 (on the first day of the acute episode) with later return to normal.

Numerous sputum examinations were made throughout this period, and they were negative for pyogens, fungi and acid fast bacilli. Numerous stool specimens were studied and cultured for parasites, including Schistosoma, and were entirely negative. Three blood cultures were likewise negative.

The patient maintained adequate prothrombin levels and was treated for one month on that regimen, until ambulation was effected. The pleuritic pain subsided in several days and sputum became thin and finally completely disappeared. Chest x-ray films revealed gradual clearing of the processes in both lung fields. Daily examination of the extremities was done for three weeks with no evidence of thrombosis at any time. He remained afebrile and essentially well throughout the rest of his hospital stay.

Following subsidence of the acute pulmonary process, attention was redirected toward the rectum and he was proctoscoped on the 28th hospital day, when preliminary digital examination again revealed an induration along the posterior wall of the rectum, roughly 6 cm. above the anal opening. Because of marked tenderness in that area, a limited proctoscopy was performed and there was noted an area of irregular and shallow ulceration along the lower 6 cm. of rectal mucosa. The proctoscope with difficulty was inserted to 12 cm., where similar but smaller ulcerations were noted. A small area of muco-sanguinous material was observed. Biopsy was postponed because of the marked pain produced by instrumentation. It was felt that acute proctitis existed. Stool studies for parasites and cultures for amebae were made at that time and were negative, as was complement-fixation tests for amebiasis. The possibility of an acute proctitis secondary to lymphopathia venereum was raised and studies were made with this in mind. A complement-fixation test for lymphopathia venereum on March 6, 1948, over one month after admission, showed a doubtful reaction at a 1:5 dilution and a negative

FIGURE 1

FIGURE 2

reaction at 1:20 dilution. The Kahn remained at less than 10 K.U. A Frei test done at this time was markedly positive. At no time did he have inguinal lymphadenopathy and he did not recall a recent penile lesion. Because of the possibility that he had lymphopathia venereum proctitis, he was treated with sulfadiazine for one month with gradual subsidence of rectal pain and mucoid rectal discharge. Approximately 70 days after admission (and two weeks following discharge) he was reproctoscoped to a distance of 10 inches. No ulceration was noted, but at the site of previous ulcers, dull, depressed atrophic patches, suggestive of scars, were noted. The mucous membrane was somewhat friable and bled on touch. The previously noted indurated granular areas above the anal opening were still present, but no longer tender. It was the impression that these latter areas were the residuals of a periphlebitis. Smear and cultures from these lesions were negative. Barium enema on March 5 revealed slight irregularity of the rectal mucosa. A repeat study in April 1948 was interpreted as normal.

When last seen in May 1948, the patient had no rectal or pulmonary symptom and his chest x-ray film revealed pleural thickening at both bases (Figure 2).

Discussion

Anatomy.[7] The hypogastric or internal iliac vein drains much of the pelvic viscera, and it in turn joins the systemic circulation by uniting with the external iliac vein at the pelvic brim. Among tributaries which join this vein are the internal pudendal with its origins outside the pelvis and the middle hemorrhoidal veins originating in the pelvic viscera. The hemorrhoidal plexus surrounds the rectum and consists of an internal portion lying in the submucosa immediately above the anal opening and an external portion in the muscularis. This internal portion communicates freely with the external plexus and in turn with the vesical plexus. The inferior hemorrhoidal veins drain the lower portions of these plexuses by connection with the internal pudendal vein. The middle portion is drained by the middle hemorrhoidal vein and the latter joins the hypogastric vein. Only the upper portion of the rectum drains into the portal system, but because of the plexus arrangement, there is free communication between the portal and systemic circulations.

Four criteria must be satisfied to establish the hemorrhoidal plexus or rectal area as a source of systemic embolization; namely, anatomical, clinical, pathological and experimental.

1) From the discussion of the anatomy of this area (vide supra), it is clear that with the exception of the most superior portions of the rectum, there is free intercommunication between the rectal venous circulation and the systemic circulation. On morphologic grounds, there is no reason why the rectum could not serve as a source of venous systemic embolization.

2) If the rectum is to be clearly implicated as a source of pulmonary emboli, it would appear reasonable to demand some clinical and pathologic association of hemorrhoidal disease with pulmonary artery embolization. Since thrombotic hemorrhoidal disease is so common, pulmonary embolism should be a common clinical occurrence, provided there are no special factors tending to prevent it. With the exception of King's report of several cases of pulmonary infarction possibly associated with rectal lesions,[8] a review of the literature and common clinical experience reveal no definite association of pulmonary embolism and rectal pathology. This may possibly be explained, in part, by the anatomy of the hemorrhoidal veins.[9] They are in the nature of varicosities and like those in the extremities, would probably not often be the source of embolism. An adequate explanation, however, of the absence of embolism in association with hemorrhoids is not at hand.

3) There is scarcely any pathological evidence to implicate the rectum as a source of pulmonary embolism. Allen,[2] Spain,[10] Neuhof[5] and others, in reviewing the sites of systemic emboli, do not mention the rectum as a possible source. Moran[6] has published post-mortem material in which he lists a total of three patients in whom he felt hemorrhoidal thrombi were the source of pulmonary emboli. Unfortunately no details are given in this paper and there is no indication as to how complete the necropsies were. The pathological proof is therefore open to question in that series.

The failure of the pathologic reports on pulmonary infarction to implicate the rectum as a source of embolization may be due to the fact that the rectum and its circulation is not examined carefully in routine autopsies. Even in those cases of pulmonary embolism where the source was not obvious, examination of the rectal circulation was not made.[10]

To prove pathologically that the rectum was the source of any given pulmonary embolus, one would require absence of thrombi in the usual locations, such as the deep veins of the extremity, and in addition, the presence of thrombosis in the inferior or middle hemorrhoidal venous plexus, and histologic similarity of the embolus in the pulmonary artery to the original hemorrhoidal thrombus.

The enormity of the above task in routine post-mortem work makes it understandable that the rectal circulation has been ignored in studies of thromboembolic disease.

It is of interest that in a number of pathological studies, the source of the pulmonary emboli were not found in a high percentage of cases; for example, 42 per cent of 200 cases (84 cases), in the series of Spain and Moses.[10] In many of these studies it is

not made clear how often failure to find the source was due to lack of a complete examination, including leg dissection. It seems reasonable to suppose that in cases of pulmonary emboli in which examination of the usual sites of thrombi is negative, a careful search of pelvic veins, including the hemorrhoidal veins, might uncover their source.

4) Experimental criteria: A careful search of the literature reveals no record of any attempt to demonstrate the possibility of pulmonary embolization from experimentally induced hemorrhoidal thrombi. This might prove a fruitful field of investigation.

This case is presented as an instance of recurrent pulmonary infarctions in an ambulatory patient. There was no clinical evidence of thrombosis in the peripheral veins or the heart. There was, however, a severe inflammatory process in the rectum, associated with hemorrhoidal disease, which conceivably could have been the source of the emboli. The nature of this inflammatory process remains obscure. In view of the positive Frei test and the good clinical response to sulfadiazine therapy, it is possible that this process represented a lymphopathia venereum proctitis. A review of the literature on this subject does not reveal any reported instance of the association of pulmonary infarction and lymphopathia venereum.

In the series of 10 cases of pulmonary embolism occurring in ambulant and well Army personnel, reported by King et al.,[8] it is of great interest that in two cases pulmonary infarcts were associated with thrombosing, acute hemorrhoidal disease. Phlebography of the lower extremities in both these cases revealed no evidence of thrombosis.

It is anticipated that objection to the concept proposed in this paper may be made on the ground that neither this patient nor others referred to were studied by phlebography. It must be admitted that phlebograms here might have demonstrated thrombosis in the veins of the lower extremities. It is recognized, however, that the diagnostic value of phlebography in diagnosis of obscure sources (clinically inapparent) of pulmonary emboli is questionable.[2] Allen[2] found negative phlebograms in one-third of his cases of obvious clinical thrombotic disease of the lower extremity. Conversely, it is known[2] that erroneous diagnosis of thrombosis may be made on phlebograms either because of venospasm due to the contrast media and venipuncture, or because of artifacts resulting from position of the extremity.

SUMMARY

An unusual case of multiple pulmonary infarctions occurring in a presumably well, ambulant and active young male has been

presented. Clinically it was striking that the embolic disease occurred in association with an unusual inflammatory process involving the hemorrhoidal veins which may have been due to the virus of lymphopathia venereum. It is recognized that this association may be coincidental, but it is suggested that the hemorrhoidal veins may have been the source of these emboli since no other was demonstrated.

The hypothesis presented above merits consideration, and it is hoped that in some small measure this report will stimulate clinical, pathological and experimental investigation of the rectal circulation in relation to pulmonary embolism.

RESUMEN

Es presentado un caso raro de infartos pulmonares múltiples en un varón joven ambulante, activo y al parecer sano. Clínicamente llamó la atención el hecho de que la enfermedad embólica ocurrió asociada a un proceso raro de inflamación de las venas hemorroidales, que podía ser causado por el virus de linfopatía venérea. Se reconoce que tal asociación puede ser una coincidencia, pero se sugiere que las venas hemorroidales pueden haber sido el origen de estos émbolos, ya que no se demostró ninguno otro.

Lt hipótesis que se presenta merece consideración, y es de esperarse que, aunque sea en forma limitada, este informe estimule la investigación clínica, patológica y experimental de la circulación rectal en relación a la embolia pulmonar.

RESUME

Les auteurs rapportent un cas d'infarctus pulmonaires multiples, qui sont apparus chez un jeune homme bien portant, valide et en parfaite activité.

Cliniquement, il était frappant de constater que ces embolies s'associaient avec un processus inflammatoire atteignant les veines hémorroïdaires, dont la cause semblait être le virus de la maladie de l'adéno-lymphoïdite. Les auteurs reconnaissent qu'il peut s'agir là d'une associations de coïncidences mais ils suggèrent de considérer les veines hémorroïdaires comme la source de ces embolies en l'absence de toute autre origine reconnue.

Cette hypothèse demande à être prise en considération, et les auteurs souhaitent que leur rapport puisse encourager des recherches cliniques, anatomiques et expérimentales sur les relations entre l'état des vaisseaux du rectum et les embolies pulmonaires.

REFERENCES

1 Homans, J.: "Pulmonary Embolism Due to Quiet Venous Thromboses and Simulating Cardiac and Pulmonary Disease," *New England J. of Med.*, 229:309, 1943.

2 Allen, A. W., et al.: "Thrombosis and Embolism: Review of 202 Patients Treated by Femoral Vein Interruption," *Ann. Surgery*, 118:728, 1943.

3 Hampton, A. O. and Castleman, B.: "Correlation of Postmortem Chest Teleoroentgenograms with Autopsy Findings, with Special Reference to Pulmonary Embolism and Infarction," *Am. J. Roent.*, 43:305, 1940.

4 Dougherty, J. and Homans, J.: "Venography, A Clinical Study," *Surg., Gynec. and Obst.*, 71:697, 1940.

5 Neuhof, H. and Klein, S. H.: "Massive Pulmonary Embolism Based in Part on Study of 88 Fatal Cases," *J. Mt. Sinai Hospital*, 13:32, 1946.

6 Moran, T. J.: "Pulmonary Embolism in Nonsurgical Patients with Prostatic Thrombosis," *Am. J. Clin. Path.*, 17:205, 1947.

7 Gray, H.: "Anatomy of the Human Body," XXIII edition, p. 671.

8 King, J., et al.: "Pulmonary Embolism from Obscure Sources," *Transactions of the Association of American Physicians*, 58:92, 1944.

9 Callendar, C. L.: "Surgical Anatomy," 2nd edition, pages 504 and 508.

10 Spain, D. and Moses, J.: "Thrombosis and Embolism of Pulmonary Vessels with Special Reference to Pulmonary Vein Thrombosis," *Am. J. Med. Sciences*, 212:707, 1946.

Optimal Time of Expansion of Artificial Pneumothorax*

A Study of 445 Adequate Pneumothoraces

HAROLD GUYON TRIMBLE, M.D., F.C.C.P.,
J. LLOYD EATON, M.D., F.C.C.P. and
INA GOURLEY, M.D., F.C.C.P.
Oakland, California

This is a study of 445 *adequate* pneumothoraces established in 412 patients (bilateral consecutive pneumothoraces in the same patient were considered as two cases). Attempted pneumothoraces which did not become adequate are not included in this study. We define *adequate collapse* as sputum absent or negative on concentration, and cavities, if any, closed on roentgenogram.† Adequate collapse according to this definition does not require negative culture or guinea pig inoculation after gastric or tracheal wash. Because of reactivation of the disease, complications, etc., a certain number of these adequate pneumothoraces had to be stopped before the point of being voluntarily discontinued. These cases will show early results of adequate collapse. A larger number of cases had their pneumothorax discontinued voluntarily or were found to be nonexpansile; these cases have had a longer time of follow-up and will give later results.

The following tabulation classifies the cases covered in this report. We would have liked to classify the disease by segments but in going back over the x-ray films they did not lend themselves to this.

445 *adequate* pneumothoraces (412 patients):
386 (87 per cent) adequate without or before pneumonolysis.
59 (13 per cent) adequate only after pneumonolysis.

Minimal unilateral	59	
Minimal bilateral	5	
Total minimal cases		64
Moderately advanced, unilateral, without cavity	72	
Moderately advanced, unilateral, with cavity	90	
Moderately advanced, bilateral, without cavity	31	
Moderately advanced, bilateral, with cavity	39	
Total moderately advanced cases		232

*Presented at the 17th Annual Meeting of the American College of Chest Physicians, Atlantic City, New Jersey, June 7-10, 1951.
†"Diagnostic Standards," National Tuberculosis Association, 1940.

Far advanced, unilateral, without cavity	2	
Far advanced, unilateral, with cavity	36	
Far advanced, bilateral, without cavity	6	
Far advanced, bilateral, with cavity	58	
Total far advanced cases		102
Simultaneous bilateral pneumothoraces:		
One side minimal, other moderately advanced	2	
One side minimal, other far advanced	2	
Both sides moderately advanced	14	
One side moderately advanced, other far advanced	12	
Both sides far advanced	17	
Total simultaneous bilateral pneumothoraces		47
Grand total		445

From the following tabulation on sputum conversion it will be seen that, of the 33 minimal cases having positive sputum and on whom we have adequate conversion records, 30 (91 per cent) converted to negative sputum in less than two months after pneumothorax was started; of the 171 moderately advanced cases, 88 (51 per cent) converted in less than two months; and of the 100 far advanced cases, only 19 (19 per cent) converted in less than two months, while 32 (32 per cent) required longer than one year to become negative.

Sputum Conversion

Minimal Cases:

64 plus four simultaneous bilateral pneumothoraces — 68 cases.
- 30 converted in less than two months.
- 1 converted in four to six months.
- 2 converted in longer than 12 months.
- 33 had no positive sputum at beginning or during pneumothorax.
- 2 inadequate records of date of conversion.
- 68 — Total.

Moderately Advanced Cases:

232 plus 26 simultaneous bilateral pneumothoraces — 258 cases.
- 88 converted in less than two months.
- 27 converted in two to three months.
- 33 converted in four to six months.
- 9 converted in seven to nine months.
- 3 converted in 10 to 12 months.
- 11 converted in longer than 12 months.
- 48 had no positive sputum at beginning or during pneumothorax.
- 39 inadequate records of date of conversion.
- 258 — Total.

Far Advanced Cases:

102 plus 17 simultaneous bilateral pneumothoraces — 119 cases.
- 19 converted in less than two months.
- 12 converted in two to three months.
- 25 converted in four to six months.
- 8 converted in seven to nine months.

4 converted in 10 to 12 months.
32 converted in longer than 12 months.
6 had no positive sputum at beginning or during pneumothorax.
13 inadequate records of date of conversion.
119 — Total.

The data on sputum conversion are shown more concisely in Chart 1.

Tables I, II and III show, according to extent of disease, the length of time artificial pneumothorax was maintained and the reason for discontinuance in all pneumothoraces except in the nonexpansile cases, which are covered in Table XIII. Of the 61 minimal cases shown in Table I, 45 (74 per cent) had their pneumothorax discontinued voluntarily; 16 (26 per cent) did not have their pneumothorax voluntarily discontinued. The reasons are detailed in the table. Of the 235 moderately advanced cases shown in Table II, 175 (74 per cent) had their pneumothorax discontinued voluntarily; 60 (26 per cent) did not have their pneumo-

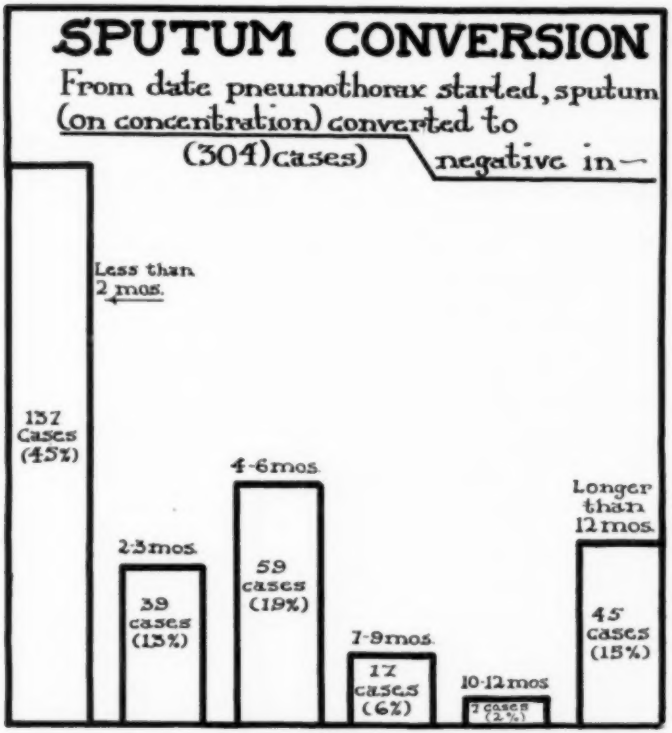


CHART 1

TABLE I: LENGTH OF TIME PNEUMOTHORAX WAS MAINTAINED IN MINIMAL CASES, WITH REASON FOR DISCONTINUANCE (61 CASES)

Extent of Pulmonary Disease	Time Pneumothorax Treatment Maintained	Number of Cases	PNEUMOTHORAX DISCONTINUED						
			Voluntarily	Because of Complications	Against Advice	— — Because of Reactivation — — Same Side as Pnx.	Opposite Side from Pnx.	Both Sides	Because of Death
Minimal	6-11 mos.	5	1	3			1*		
57 Cases	12-23 mos.	4	3		1				
	24-35 mos.	16	11	1	1		3		
	36-47 mos.	16	14				2		
	48-59 mos.	8	6	2					
	60-72 mos.	7	6				1*		
	7 yrs.	1	1						
TOTALS		57	42	6	2		7		
Simultaneous Bilateral	36-47 mos.	2	1	1					
Pneumothorax	7 yrs.	1	1						
4 Cases	8 yrs.	1	1						
TOTALS		4	3	1					
GRAND TOTAL		61	45	7	2		7		

*Patient died later.

thorax voluntarily discontinued. In 35, a little over half of these 60 cases, pneumothorax was discontinued because of complications; and one-fourth were discontinued because of reactivation on the opposite side. Of the 101 far advanced cases shown in Table III, 57 (56 per cent) had their pneumothorax discontinued voluntarily; 44 (44 per cent) did not have their pneumothorax voluntarily discontinued. In 20, or about one-half of these 44 cases, pneumothorax was discontinued because of complications; and in 13 (30 per cent) because of reactivation on the opposite side. There were 120 pneumothoraces (30 per cent of the 397 adequate pneumothoraces) which did not reach the point of being voluntarily discontinued, even though adequate collapse had been obtained. Of these 120 cases, pneumothorax was discontinued because of reactivation of disease in 44 cases (37 per cent), and because of complications in 62 cases (52 per cent). As will be seen from Tables I, II and III, those reactivations causing pneumothorax treatment to be discontinued tended to occur during the first three years of treatment, whereas the complications tended to develop at any time during treatment.

In the 61 minimal cases having pneumothorax discontinued voluntarily or otherwise (because of reactivation, death, complications and institution of other treatment), there were 12 (20 per cent) known reactivations; in the 235 moderately advanced cases, 54 (23 per cent) known reactivations; and in the 101 far advanced cases there were 35 (35 per cent).

In the 24 pneumothoraces discontinued after six to 11 months, voluntarily or otherwise (Tables I, II and III), there were 5 (21 per cent) reactivations—three patients (13 per cent) had reactivation while pneumothorax therapy was still being given. Of these five reactivations, one (20 per cent) occurred on the same side on which pneumothorax was given, three (60 per cent) on the opposite side, and one (20 per cent) on both sides.

In the 42 pneumothoraces discontinued after 12 to 23 months, there were 19 (45 per cent) reactivations—eight patients (19 per cent) had reactivation while pneumothorax was still being given. Of these 19 reactivations, six (32 per cent) occurred on the same side on which pneumothorax was given, seven (36 per cent) on the opposite side, and six (32 per cent) on both sides.

In the 81 pneumothoraces discontinued after 24 to 35 months, there were 36 (44 per cent) reactivations—18 patients (22 per cent) had reactivation while pneumothorax was still being given. Of these 36 reactivations, four (11 per cent) occurred on the same side on which pneumothorax was given, 24 (67 per cent) on the opposite side, and eight (22 per cent) on both sides.

In the 99 pneumothoraces discontinued after 36 to 47 months,

TABLE II: LENGTH OF TIME PNEUMOTHORAX WAS MAINTAINED IN MODERATELY ADVANCED CASES, WITH REASON FOR DISCONTINUANCE (235 CASES)

Extent of Pulmonary Disease	Time Pneumothorax Treatment Maintained	Number of Cases	PNEUMOTHORAX DISCONTINUED						
			Voluntarily	Because of Complications	Against Advice	Because of Reactivation — Same Side as Pnx.	Because of Reactivation — Opposite Side from Pnx.	Because of Reactivation — Both Sides	Because of Death
Moderately Advanced Without Cavity 93 Cases	6-11 mos.	5		4				1*	
	12-23 mos.	7	4	1			2*		
	24-35 mos.	13	5	4	1		2		1
	36-47 mos.	23	17	1		1	1	1*	2
	48-59 mos.	15	13				2*		
	60-72 mos.	22	21	1					
	7 yrs.	5	5						
	8 yrs.	1	1						
	10 yrs.	2	2						
TOTALS		93	68	11	1	1	7	2	3
Moderately Advanced With Cavity 117 Cases	6-11 mos.	4		4					
	12-23 mos.	12	4	7				1*	
	24-35 mos.	27	18	2	1		6		
	36-47 mos.	34	30	3			1*		
	48-59 mos.	20	17	2			1*		

TABLE II (Continued)

Extent of Pulmonary Disease	Time Pneumothorax Treatment Maintained	Number of Cases	PNEUMOTHORAX DISCONTINUED						
			Voluntarily	Because of Complications	Against Advice	Because of Reactivation — Same Side as Pnx.	Because of Reactivation — Opposite Side from Pnx.	Because of Reactivation — Both Sides	Because of Death
	60-72 mos.	12	10	2*					
	7 yrs.	3	3						
	8 yrs.	3	3						
	10 yrs.	2	1	1					
TOTALS		117	86	21	1		8	1	
Simultaneous Bilateral	6-11 mos.	1		1*					
Pneumothorax	12-23 mos.	2		2					
25 Cases	24-35 mos.	6	5					1	
	36-47 mos.	2	2						
	48-59 mos.	5	5						
	60-72 mos.	7	7						
	7 yrs.	1	1						
	8 yrs.	1	1						
TOTALS		25	21	3				1	
GRAND TOTAL		235	175	35	2	1	15	4	3

*1 patient died later.

there were 20 (20 per cent) reactivations—eight (8 per cent) had reactivation while pneumothorax was still being given. Of these 20 reactivations, six (30 per cent) occurred on the same side on which pneumothorax was given, 11 (55 per cent) on the opposite side, and three (15 per cent) on both sides.

In the 58 pneumothoraces discontinued after 48 to 59 months, there were 11 (19 per cent) reactivations—six (10 per cent) had reactivation while pneumothorax was still being given. Of these 11 reactivations, two (18 per cent) occurred on the same side on which pneumothorax was given, eight (73 per cent) on the opposite side, and one (9 per cent) on both sides.

In the 58 pneumothoraces discontinued after 60 to 72 months, there were eight (14 per cent) reactivations—one (2 per cent) had reactivation while pneumothorax was still being given. Of these eight reactivations, three (37.5 per cent) occurred on the same side on which pneumothorax was given, two (25 per cent) on the opposite side, and three (37.5 per cent) on both sides.

In the 17 pneumothoraces discontinued after seven years, there was one (6 per cent) reactivation, which occurred on the opposite side.

In the seven pneumothoraces discontinued after eight years, the four discontinued after nine years, the four discontinued after 10

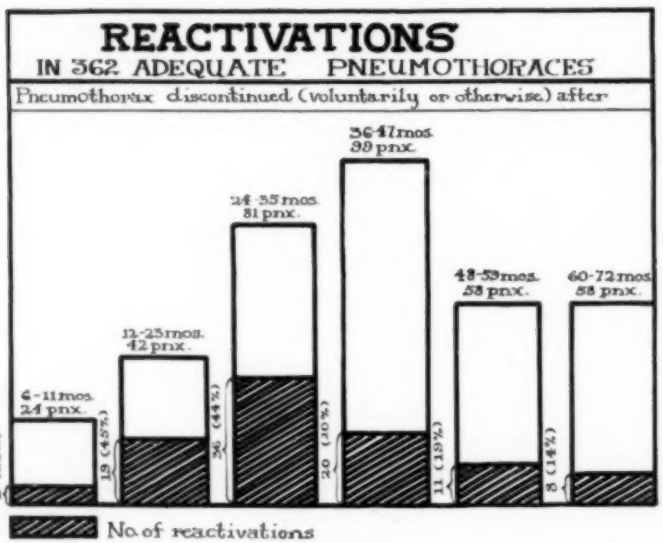


CHART 2

years, the one discontinued after 11 years and the one discontinued after 19 years there were no reactivations.

The one patient whose pneumothorax was discontinued after 17 years had reactivation on the same side on which pneumothorax was given in less than two years after pneumothorax was discontinued.

In the 397 adequate pneumothoraces discontinued voluntarily or otherwise, there were 101 (25 per cent) reactivations; and in the 48 nonexpansile cases (Table XIII) there were six (13 per cent) reactivations. Thus, there was a total of 107 (24 per cent) reactivations in the 445 adequate pneumothoraces.

The over-all picture of reactivations occurring in pneumothoraces maintained for the periods of six to 11 months to 60 to 72 months is shown in Chart 2. After 36 months of collapse the number of cases having reactivation drops off sharply. These

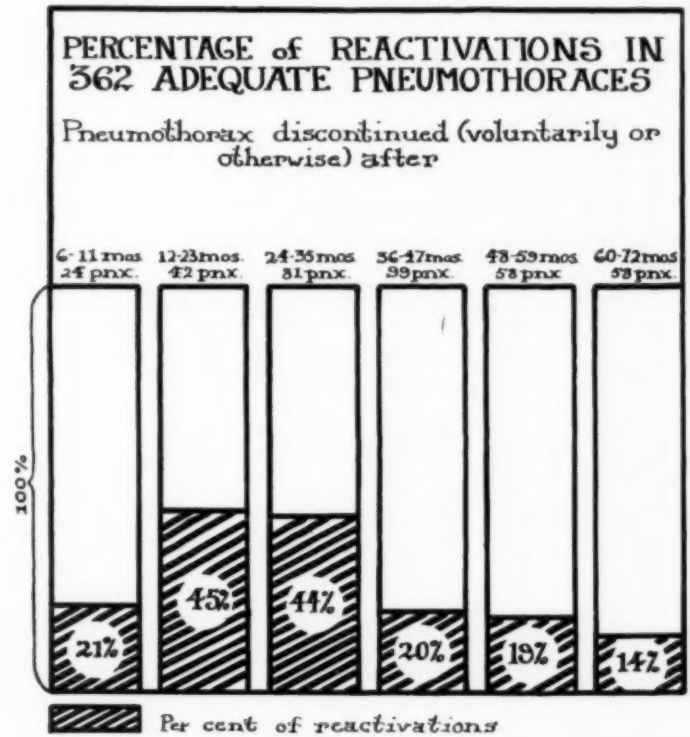


CHART 3

TABLE III: LENGTH OF TIME PNEUMOTHORAX WAS MAINTAINED IN FAR ADVANCED CASES, WITH REASON FOR DISCONTINUANCE (101 CASES)

Extent of Pulmonary Disease	Time Pneumothorax Treatment Maintained	Number of Cases	PNEUMOTHORAX DISCONTINUED						
			Voluntarily	Because of Complications	Against Advice	Because of Reactivation — Same Side as Pnx.	Because of Reactivation — Opposite Side from Pnx.	Because of Reactivation — Both Sides	Because of Death
Far Advanced	12-23 mos.	3	1				2*		
Without Cavity	24-35 mos.	2		1			1		
8 Cases	60-72 mos.	2	2						
	7 yrs.	1	1						
TOTALS		8	4	1			3		
Far Advanced	6-11 mos.	7		5			1*		1
With Cavity	12-23 mos.	10	3	3	2	1			1
76 Cases	24-35 mos.	16	8	2	1	1	4		
	36-47 mos.	19	13	4			2		
	48-59 mos.	10	5	2*			3*		
	60-72 mos.	5	5						
	7 yrs.	2	1	1					
	8 yrs.	1	1						

TABLE III (Continued)

Extent of Pulmonary Disease	Time Pneumothorax Treatment Maintained	Number of Cases	PNEUMOTHORAX DISCONTINUED						
			Voluntarily	Because of Complications	Against Advice	— — Because of Reactivation — — Same Side as Pnx.	Opposite Side from Pnx.	Both Sides	Because of Death
	9 yrs.	4	3	1					
	11 yrs.	1	1						
	17 yrs.	1	1						
TOTALS		76	41	18	3	2	10		2
Simultaneous Bilateral	6-11 mos.	2							2
Pneumothorax	12-23 mos.	4	1	1				2**	
17 Cases	24-35 mos.	1	1						
	36-47 mos.	3	3						
	60-72 mos.	3	3						
	7 yrs.	3	3						
	19 yrs.	1	1						
TOTALS		17	12	1				2	2
GRAND TOTAL		101	57	20	3	2	13	2	4

*1 patient died later. **2 patients died later.

reactivations are shown by percentages is Chart 3. The location of these reactivations is shown in Chart 4 and, as will be seen from this chart, reactivations occurred more than twice as often on the opposite side than on the same side on which pneumothorax treatment was given.

TABLE IV

Results, According to Time of Follow-up, in Minimal Cases in Which Pneumothorax Was Discontinued Voluntarily

42 Cases (66 per cent of the 64 minimal cases)

Time Followed After Pneumothorax Discontinued	Number of Cases	Continued Arrested	— — — REACTIVATION — — — Same Side as Pnx.	Opposite Side from Pnx.	Both Sides	Died
Less than 1 yr.	8	8				
12-23 mos.	8	6		1	1	
24-35 mos.	4	4				
36-47 mos.	7	5		2		
48-59 mos.	7	6	1			
5 yrs.	4	4				
7 yrs.	2	2				
8 yrs.	1	1				
11 yrs.	1	1				
TOTALS	42	37	1	3	1	

TABLE V

Results, According to Time Pneumothorax Maintained, in Minimal Cases in Which Pneumothorax Was Discontinued Voluntarily

42 Cases (66 per cent of the 64 minimal cases)

Time Pneumothorax Treatment Maintained	Number of Cases	Continued Arrested	— — — REACTIVATION — — — Same Side as Pnx.	Opposite Side from Pnx.	Both Sides	Died
6-11 mos.	1	1				
12-23 mos.	3	2	1			
24-35 mos.	11	8		2	1	
36-47 mos.	14	13		1		
48-59 mos.	6	6				
60-72 mos.	6	6				
7 yrs.	1	1				
TOTALS	42	37	1	3	1	

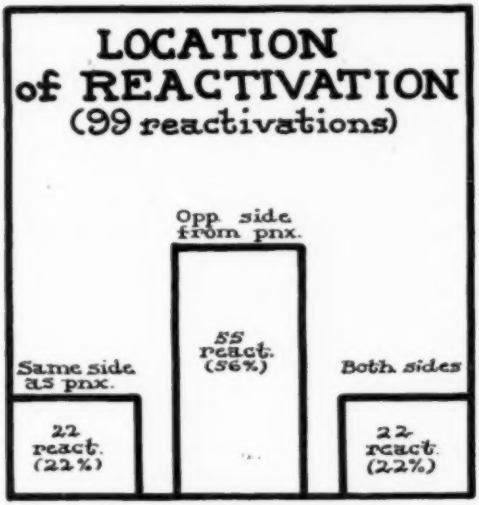


CHART 4

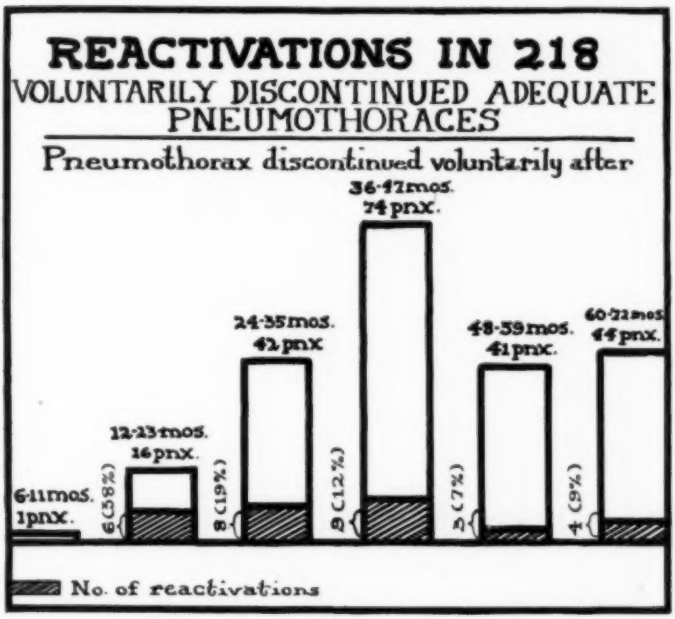


CHART 5

Voluntarily Discontinued Pneumothoraces

Up to this point we have been discussing the over-all picture of the 445 adequate pneumothoraces. We now wish to discuss a select group out of these 445 adequate pneumothoraces, that is, those pneumothoraces which, after becoming adequate, were continued for the length of time that was desired by the physician and in which the abandonment of the procedure was completely voluntary. Our purpose in analyzing this select group out of the over-all group is to see what pneumothorax accomplishes under ideal conditions.

From the data on these voluntarily discontinued pneumothoraces (Tables IV to XI) it will be seen that, out of the total 64 minimal cases, in only 42 (66 per cent) was pneumothorax discontinued voluntarily; out of the total 232 moderately advanced cases the same percentage (66 per cent) could be voluntarily discontinued;

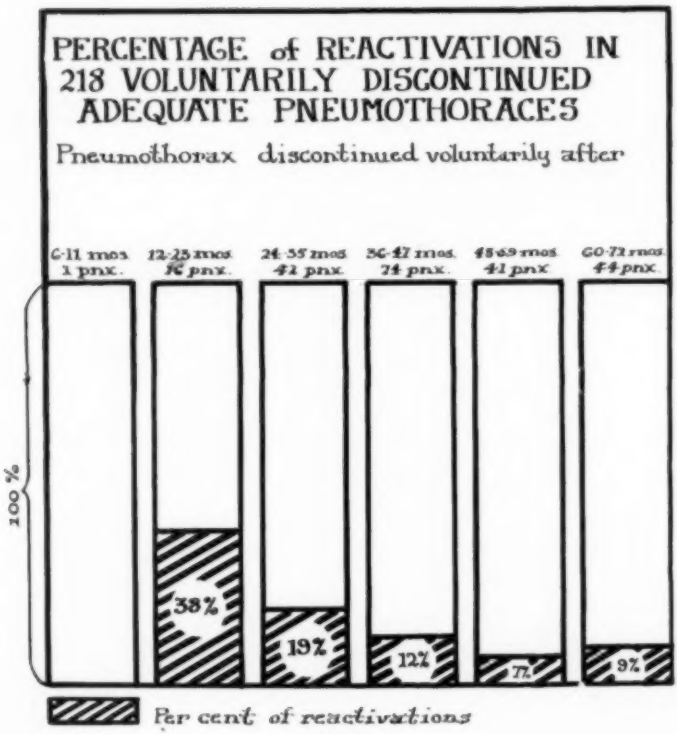


CHART 6

out of the 102 far advanced cases, 45 (44 per cent) had their pneumothorax voluntarily discontinued; and of the 47 simultaneous bilateral pneumothoraces, 36 (77 per cent) were voluntarily discontinued.

In the 42 minimal cases in which pneumothorax was voluntarily discontinued, there were five (12 per cent) reactivations (Tables IV and V). Of these five reactivations, one (20 per cent) occurred on the same side on which pneumothorax was given, three (60 per cent) on the opposite side, and one (20 per cent) on both sides.

In the 154 moderately advanced cases in which pneumothorax was voluntarily discontinued, there were 20 (13 per cent) reactivations (Tables VI and VII). Of these 20 reactivations, 11 (55 per cent) occurred on the same side on which pneumothorax was given, and nine (45 per cent) on the opposite side.

In the 45 far advanced cases in which pneumothorax was voluntarily discontinued, there were eight (18 per cent) reactiva-

TABLE VI

Results, According to Time of Follow-up, in Moderately Advanced Cases in Which Pneumothorax Was Discontinued Voluntarily

154 Cases (66 per cent of the 232 moderately advanced cases)

Time Followed After Pneumothorax Discontinued	Number of Cases	Continued Arrested	— — — REACTIVATION — — — Same Side as Pnx.	Opposite Side from Pnx.	Both Sides	Died
Less than 1 yr.	27	25	1	1		
12-23 mos.	23	18	3	2		
24-35 mos.	10	8	1	1		
36-47 mos.	21	18	1*	2		*died
48-59 mos.	23	21	1	1		
5 yrs.	6	5	1			
6 yrs.	8	8				
7 yrs.	11	9	1	1		
8 yrs.	4	4				
9 yrs.	9	7	2			
10 yrs.	4	4				
11 yrs.	2	2				
12 yrs.	1	1				
13 yrs.	3	2		1		
16 yrs.	1	1				
19 yrs.	1	1				
TOTALS	154	134	11	9		1

tions (Tables VIII and IX). Of these eight reactivations, three (37.5 per cent) occurred on the same side on which pneumothorax was given, three (37.5 per cent) on the opposite side, and two (25 per cent) on both sides.

TABLE VII

Results, According to Time Pneumothorax Maintained, in Moderately Advanced Cases in Which Pneumothorax Was Discontinued Voluntarily

154 Cases (66 per cent of the 232 moderately advanced cases)

Time Pneumothorax Treatment Maintained	Number of Cases	Continued Arrested	REACTIVATION			
			Same Side as Pnx.	Opposite Side from Pnx.	Both Sides	Died
12-23 mos.	8	4	3	1		
24-35 mos.	23	20	1	2		
36-47 mos.	47	41	3	3		
48-59 mos.	30	27	1*	2		*died
60-72 mos.	31	27	3	1		
7 yrs.	8	8				
8 yrs.	4	4				
10 yrs.	3	3				
TOTALS	154	134	11	9		1

TABLE VIII

Results, According to Time of Follow-up, in Far Advanced Cases in Which Pneumothorax Was Discontinued Voluntarily

45 Cases (44 per cent of the 102 far advanced cases)

Time Followed After Pneumothorax Discontinued	Number of Cases	Continued Arrested	REACTIVATION			
			Same Side as Pnx.	Opposite Side from Pnx.	Both Sides	Died
Less than 1 yr.	9	7	1	1*		*died
12-23 mos.	9	7	1	1		
24-35 mos.	6	6				
36-47 mos.	5	4	1			
48-59 mos.	4	3		1*		*died
7 yrs.	3	3				
8 yrs.	2	2				
11 yrs.	1				1	
15 yrs.	3	2			1	
16 yrs.	2	2				
18 yrs.	1	1				
TOTALS	45	37	3	3	2	2

Of the above 33 reactivations (Tables IV to IX), 15 occurred on the same side on which pneumothorax was given, 15 on the opposite side, and three on both sides. In other words, half of the reactivations which occurred in lungs adequately collapsed by pneumothorax and in which treatment was voluntarily discontinued occurred on the side collapsed. This presents a different picture than shown in the over-all Chart 4.

In the 36 simultaneous bilateral pneumothoraces in which this treatment was voluntarily discontinued (Tables X and XI), there were 12 (33 per cent) reactivations.

All but seven of the 45 reactivations in the 277 voluntarily discontinued pneumothoraces occurred within the first five years after pneumothorax treatment was stopped. Of these seven reactivations, two occurred seven years after voluntary discontinuance of pneumothorax, two at nine years, one at 11 years, one at 13 years, and one at 15 years.

In the group of 218 voluntarily discontinued adequate pneumothoraces shown on Chart 5 there was reactivation of disease in 38 per cent of those cases in which pneumothorax was maintained for only 12 to 23 months, and in 19 per cent of those treated for 24 to 35 months. In those cases treated longer than three years the number of reactivations drops off sharply and remains somewhat the same up to six years' treatment. These same reactiva-

TABLE IX

Results, According to Time Pneumothorax Maintained, in Far Advanced Cases in Which Pneumothorax Was Discontinued Voluntarily

45 Cases (44 per cent of the 102 far advanced cases)

Time Pneumothorax Treatment Maintained	Number of Cases	Continued Arrested	— — — REACTIVATION — — — Same Side as Pnx.	Opposite Side from Pnx.	Both Sides	Died
12-23 mos.	4	2		1*	1	*died
24-35 mos.	8	6	1		1	
36-47 mos.	13	11	1	1		
48-59 mos.	5	5				
60-72 mos.	7	7				
7 yrs.	2	1		1*		*died
8 yrs.	1	1				
9 yrs.	3	3				
11 yrs.	1	1				
17 yrs.	1		1			
TOTALS	45	37	3	3	2	2

tions are shown on a percentage basis in Chart 6, which illustrates graphically the falling off of recurrence of disease in those patients in whom pneumothorax was continued for more than three years.

TABLE X

Results, According to Time of Follow-up, in Simultaneous Bilateral Pneumothoraces in Which Pneumothorax Was Discontinued Voluntarily

36 Cases (77 per cent of the 47 simultaneous bilateral pneumothoraces)

Time Followed After Pneumothorax Discontinued	Number of Cases	Continued Arrested	Reactivation	Died
Less than 1 yr.	5	3	2	
12-23 mos.	9	5	4	
24-35 mos.	4	3	1	
36-47 mos.	8	4	4*	*1 died
48-59 mos.	4	3	1	
6 yrs.	1	1		
7 yrs.	1	1		
8 yrs.	1	1		
10 yrs.	2	2		
13 yrs.	1	1		
TOTALS	36	24	12	1

TABLE XI

Results, According to Time Pneumothorax Maintained, in Simultaneous Bilateral Pneumothoraces in Which Pneumothorax Was Discontinued Voluntarily

36 Cases (77 per cent of the 47 simultaneous bilateral pneumothoraces)

Time Pneumothorax Treatment Maintained	Number of Cases	Continued Arrested	Reactivation	Died
12-23 mos.	1		1	
24-35 mos.	6	1	5	
36-47 mos.	6	4	2	
48-59 mos.	5	4	1*	* died
60-72 mos.	10	7	3	
7 yrs.	5	5		
8 yrs.	2	2		
19 yrs.	1	1		
TOTALS	36	24	12	1

The following tabulation taken from Tables V, VII, IX and XI also shows that if pneumothorax was maintained for three years or longer the best results were obtained, that is, 86 to 97 per cent continued arrested.

277 VOLUNTARILY DISCONTINUED PNEUMOTHORACES

Time Pneumothorax Treatment Maintained	Number of Cases	CONTINUED ARRESTED Number	Per cent
6-11 mos.	1	1	
12-23 mos.	16	8	50
24-35 mos.	48	35	73
36-47 mos.	80	69	86
48-59 mos.	46	42	91
60-72 mos.	54	47	87
7-10 yrs.	29	28	97
11-19 yrs.	3	2	67
TOTAL	277	232	

Complications

In 62 cases (14 per cent) of our series of 445 adequate collapses, pneumothorax was discontinued because of complications, as listed in Table XII. We may divide these complications into three groups: (1) the complications of the pneumothorax itself, such as significant fluid, frank tuberculous empyema or mixed empyema; (2) complications of tuberculosis other than pulmonary; and (3) complications of other associated diseases. Of the complications that developed as a result of the procedure, three-fourths were pleural, consisting of significant fluid, or tuberculous or mixed empyema. Several patients developed two or three of the complications listed, and thus we find 128 occurrences of complications in the 62 cases.

Nonexpansile Cases

Although nonexpansion is a complication of pneumothorax we did not include it in our tables as such, but listed all nonexpansile cases separately in Table XIII. There were 48 cases of nonexpansile lung, or 11 per cent of the 445 adequate pneumothoraces. In other words, 1 out of 10 of our adequate pneumothoraces became nonexpansile. As shown in Table XIII, in the seven minimal nonexpansile cases there were no reactivations; in the 22 moderately advanced nonexpansile cases there were four reactivations (18 per cent); in the 18 far advanced nonexpansile cases, two reactiva-

tions (11 per cent); and in the one nonexpansile simultaneous bilateral pneumothorax there was no reactivation. In the 48 nonexpansile cases there was a total of six (13 per cent) reactivations.

Pneumothorax Discontinued Against Advice

In only seven of the 445 pneumothoraces was pneumothorax discontinued by the patient against medical advice. One of them had reactivation on the opposite side and one on the same side

TABLE XII: Complications (62 cases)

Complications	Number of Cases	Recovered	Still Ill at Latest Follow-up	Dead
Of Pneumothorax:				
Significant fluid	39	33		6
Frank tuberculous empyema	25	15	4	6
Mixed tuberculous and pyogenic empyema	10	5	1	4
Pyogenic empyema	8	8		
Obliterative pleuritis	7	7		
Spontaneous pneumothorax	5	1	1	3
Pulmonary fibrosis	3	3		
Air embolism	1			1
Bronchopleural fistula	1	1		
Of Tuberculosis:				
Tuberculous cervical adenitis	6	6		
Renal tuberculosis	5	2	1	2
Bone tuberculosis	1		1	
Intestinal tuberculosis	1	1		
Tracheobronchial disease	1	1		
Tuberculous meningitis	1			1
Other:				
Diabetes	4	2		2
Alcoholism	3	2	1	
Heart failure	3			3
Allergic asthma	1			1
Carcinoma of stomach	1			1
Cardiorenal vascular disease	1			1
Ischiorectal abscess	1	1		
TOTALS	128	88	9	31

TABLE XIII

Follow-up of Nonexpansile Cases (48 cases)

Extent and Type of Pulmonary Disease	Number of Cases	Time Pnx. Continued To Date of Latest Follow-up	Continued Arrested	Reactivation Same Side as Pnx.	Reactivation Opposite Side from Pnx.
Minimal:					
Unilateral 7 Cases	2	3- 5 yrs.	2		
	3	6- 8 yrs.	3		
	1	9-11 yrs.	1		
	1	14 yrs.	1		
Moderately Advanced:					
Unilateral without cavity 7 Cases	3	3- 5 yrs.	2		1
	1	6- 8 yrs.	1		
	2	9-11 yrs.	2		
	1	13 yrs.	1		
Unilateral with cavity 9 Cases	1	3- 5 yrs.	1		
	3	6- 8 yrs.	2		1*
	3	9-11 yrs.	2		1
	1	14 yrs.	1		
	1	17 yrs.	1		
Bilateral without cavity, 3 Cases	1	6- 8 yrs.			1**
	2	9-11 yrs.	2		
Bilateral with cavity, 3 Cases	2	6- 8 yrs.	2		
	1	9-11 yrs.	1		
Far Advanced:					
Unilateral with cavity 9 Cases	1	3- 5 yrs.	1		
	1	6- 8 yrs.	1		
	2	9-11 yrs.	1	1	
	3	12 yrs.	3		
	1	13 yrs.	1		
	1	23 yrs.	1		
Bilateral with cavity 9 Cases	1	4 yrs.	1		
	2	6- 8 yrs.	2†		
	1	11 yrs.	1		
	1	12 yrs.	1		
	1	13 yrs.			1*
	3	14 yrs.	3		
Simultaneous Bilateral Pneumothorax:					
One side moderately advanced, other far advanced, 1 Case	1	13 yrs.	1		
TOTALS	48		42	1	5

*Pneumoperitoneum started when reactivation occurred.
**Thoracoplasty done when reactivation occurred.
†Thoracoplasty done in 1 patient.

on which pneumothorax was given, 24 to 35 months after discontinuance of pneumothorax. One died seven and one-half years later of bilateral tuberculosis. One continued arrested 48 to 59 months after he stopped pneumothorax treatment against advice, and one continued arrested at eight years' follow-up. One started pneumoperitoneum shortly after discontinuing pneumothorax against advice and did well. On one patient we have no follow-up.

Deaths

There were 35 deaths (8 per cent) in the 445 adequate pneumothoraces at the time of latest follow-up on these patients (Table XIV). This follow-up period ranged from one to 19 years after discontinuance of pneumothorax. Twenty-nine (83 per cent) of the deaths were due to tuberculosis or the pneumothorax; and six (17 per cent) to nontuberculous conditions. Of the 29 deaths due to tuberculosis or the pneumothorax, 14 can probably be attributed directly or indirectly to the therapy (10 to tuberculous empyema, three to spontaneous pneumothorax, and one air embolism).

TABLE XIV: Deaths

35 Deaths (8 per cent of the 445 adequate pneumothoraces)

Extent of pulmonary disease	Number of cases in which death occurred during pnx. treatment or shortly after pnx. was discontinued because of complications or reactivation	Number of cases in which death occurred one or more years after pnx. was discontinued
Minimal 64 Cases	2 (3 per cent)	
Moderately Advanced 232 Cases	11 (5 per cent)	3[1] (1 per cent)
Far Advanced 102 Cases	8 (8 per cent)	4[2] (4 per cent)
Simultaneous Bilateral Pneumothorax		
Both sides moderately advanced, 14 Cases	1 (7 per cent)	1[3] (7 per cent)
Both sides far advanced, 17 Cases	4 (24 per cent)	1[4] (6 per cent)
TOTALS	26	9

[1]Death occurred in these three cases four or more years after pneumothorax was discontinued.

[2]Death occurred in these four cases one to seven and one-half years after pneumothorax was discontinued.

[3]Death occurred four years after pneumothorax was discontinued.

[4]Death occurred five years after pneumothorax was discontinued.

SUMMARY

A study of 445 adequate pneumothorax collapses for pulmonary tuberculosis is presented, considering the cases according to various subdivisions, such as, extent of disease, length of time collapse was maintained, length of follow-up, whether the collapse was discontinued voluntarily or not, and the complications, reactivations and deaths encountered. Data are given on sputum conversion.

Although this was somewhat a picked group of favorable cases, 120 of the 445 adequate pneumothoraces did not reach the point of being voluntarily discontinued. Of these 120 cases, pneumothorax had to be discontinued because of reactivation of disease in 44 (37 per cent), because of complications in 62 cases (52 per cent), because of death in seven cases, and against medical advice in seven cases. These reactivations tended to occur during the first three years of treatment, whereas the complications in the 62 cases tended to develop at any time during treatment. There were 48 cases of nonexpansile lung, with six late reactivations.

From the findings in the 277 cases in which pneumothorax was voluntarily discontinued, it would seem that pneumothorax collapse of three years or longer gives the best results. Of the 212 voluntarily discontinued cases in which pneumothorax was maintained for three years or longer, 188 (89 per cent) remained arrested at latest date of follow-up. In the 277 voluntarily discontinued pneumothoraces there were 45 reactivations of disease, all but seven of which occurred within the first five years after pneumothorax was discontinued. The occurrence of reactivations dropped from 38 per cent in the group treated for 12 to 23 months to 19 per cent in the group treated for 24 to 35 months and to 12 per cent or less in the cases in which pneumothorax was maintained for three years or longer.

Reactivations which occurred during pneumothorax tended to be on the untreated side, but reactivations which occurred after voluntary discontinuance of pneumothorax were about equal on the side of collapse and on the opposite side.

There were 35 deaths (8 per cent) in the 445 adequate pneumothoraces at the time of latest follow-up on these patients—two deaths in the minimal cases, 14 in the moderately advanced, 12 in the far advanced, and seven in the simultaneous bilateral pneumothoraces.

RESUMEN

Se presenta el estudio de 445 casos de neumotorax adecuado por tuberculosis pulmonar, considerando los casos de acuerdo con varias subdivisiones, tales como la extensión de la enfermedad, el tiempo que el colapso fué mantenido, tiempo de observación, si el

colapso fué interrumpido voluntariamente o no, y las complicaciones, reactivaciones y fallecimientos registrados. Los datos sobre la conversión del esputo son los que se proporcionan.

Aunque este es un grupo selecto de casos favorables, 120 de los 445 neumotorax adecuados no alcanzaron el punto de ser interrumpidos voluntariamente. De estos 120 casos, el neumotórax tuvo que interrumpirse a causa de reactivación de la enfermedad en 44 (37 por ciento), a causa de complicaciones en 62 casos (52 por ciento); a causa de fallecimiento en 7 casos y contrariando la opinión del médico en siete.

Las reactivaciones ocurrieron especialmente durante los primeros tres años del tratamiento, en tanto que las complicaciones en los 62 casos tendieron a presentarse en cualquier tiempo del tratamiento.

Hubo 48 casos de pulmón inexpansible con seis reactivaciones tardías.

De los hallazgos en 277 casos, en los que el neumotórax de tres o más años de duración da los mejores resultados. De los 212 casos en que el neumotorax fué interrumpido deliberadamente, hubo 45 reactivaciones de la enfermedad, y de éstas, todas, menos siete ocurrieron dentro de los primeros cinco años después de interrumpido el tratamiento.

La frecuencia de las reactividades desde 38 por ciento en los tratados por 12 a 23 meses; hasta 19 por ciento en los tratados de 24 a 35 meses; y 12 por ciento o menos en los que el neumo se mantuvo por tres años o más.

Las reactivaciones que ocurrieron durante el tratamiento con neumotorax tendieron a presentarse en el lado no tratado pero las reactivaciones que ocurrieron después de la suspensión voluntaria presentáronse aproximadamente por igual en uno u otro lado.

Hubo 35 muertes (8 por ciento) en los neumotorax adecuados al tiempo de la última revisión en estos enfermos. Dos muertes en los casos mínimos, 14 en los moderadamente avanzados, y siete en los neumotorax bilaterales simultaneos.

RESUME

Les auteurs rapportent l'étude de 445 cas de collapsothérapie par pneumothorax pour tuberculose pulmonaire. Ils les itudient en fonction de divers éléments, tels que l'étendue des lésions, la longueur du temps pendant lequel à été maintenu le collapsus, la longueur du temps pendant lequel les malades ont été régulièrement suivis, le fait que la collapsothérapie a été arrêtée volontairement ou non, et les complications: rechutes et morts. Les dates de la négativation des crachats sont précisées.

Bien que ces cas furent en quelque sorte choisis parmi les plus

favorables, 120 des 445 pneumothorax n'arrivèrent pas jusqu'au moment où on aurait pu les cesser volontairement. Ces 120 pneumothorax furent cessés pour des daisons diverses: dans 44 cas (37%), c'est une rechute qui fit interrompre le pneumothorax. Dans 62 cas (52%), ce fut à cause d'une complication; la mort survint chez 7 malades, et chez 7 autres, le pneumothorax fut cessé malgré l'avis des médecins. Les rechutes ont tendance à apparaitre au cours des trois premières années de traitement, tandis que dans les 62 cas qui furent l'objet de complications, on ne put assigner à celles-ci une date habituelle au cours du traitement. Il y eut 48 cas dans lesquels le poumon ne put reprendre son expansion et parmi eux six rechutes tardives.

D'après les constatations faites dans les 277 cas pour lesquels le pneumothorax fut interrompu volontairement, il semble que la collapsothérapie par pneumothorax donne les meilleurs résultats quand elle a été maintenue trois ans ou davantage. Sur les 212 pneumothorax qui furent interrompus volontairement et qui avaient été maintenus trois ans ou davantage, 188 (89%) restaient stabilisés à la dernière date de l'examen systématique. Sur les 277 pneumothorax qui ont été interrompus volontairement, on note 45 rechutes, à part sept cas toutes survinrent au cours des premières cinq années qui suivirent la cessation du traitement. La fréquence des rechutes tombe de 38% dans la catégorie où le traitement s'étendit sur 12 à 23 mois, jusqu'à 19% dans la catégorie où les pneumothorax furent maintenus de 24 à 35 mois, et à 12% ou moins pour les cas dans lesquels le pneumothorax fut maintenu trois ans ou davantage. Les rechutes qui survinrent au cours du traitement par pneumothorax sont généralement situées sur le côté opposé mais les rechutes qui apparaissent après l'abandon volontaire du pneumothorax étaient également situées soit du côté du collapsus soit du côté opposé.

Il y eut 35 morts (8%) sur les 445 pneumothorax notés lors du dernier recensement de ces malades. Deux morts concernaient des cas discrets, 14 des cas modérément avancés, 12 des cas très avancés et 7 des cas de pneumothorax bilatéraux.

Studies of Respiratory Air Flow in Measurement of Ventilatory Function*

DONALD F. PROCTOR, M.D.
Baltimore, Maryland

Since dyspnoea is one of the most common serious symptoms of pulmonary disease, the physician who treats dyspnoeic patients should have at his command reliable and reasonably simple methods of quantitating the relationship between this symptom and reduction in ventilatory reserve.

The best measures of ventilatory reserve are the voluntary maximum breathing capacity or any quantitative test of a person's ability to increase ventilation with exercise. These methods fail to provide information in regard to the nature of underlying defects in the ventilatory mechanism.

During the past five years we have been interested in the development of the pneumotachograph as a method of studying ventilatory function.[1-4] The pneumotachogram, the recording of air flow velocity as a function of time, was first employed by Fleisch in 1925[5] and since that time its possibilities have been explored by numerous workers chiefly in Germany, Switzerland and this country.

The presumption that the pneumotachogram is a practical and useful method for the study of pulmonary ventilation is based on the hypothesis that the pattern of respiratory air flow velocity is a function of the forces involved in respiration under normal or abnormal conditions.

The simplest apparatus for recording the pneumotachogram would consist of the pneumotachometer, most commonly with monel mesh screen, a membrane (or other simple mechanical) differential manometer with mirror attached for photographic recording, and a camera with timing marker. For several years we

*From the Department of Otolaryngology, The Johns Hopkins University School of Medicine, Baltimore, Maryland.

This work has been supported by Grants in Aid from the United States Public Health Service. Work was done with the cooperation of members of the Physiological Division of the Department of Medicine, Janet B. Hardy of the Department of Pediatrics of the Johns Hopkins University School of Medicine, and the technical assistance of Mary Linderman.

Some of the illustrations in this article are reproduced with the permission of the Bulletin of the Johns Hopkins Hospital and the W. B. Saunders Company.

Presented at the 17th Annual Meeting of the American College of Chest Physicians, Atlantic City, New Jersey, June 7-10, 1951.

have been using strain gage manometers and amplifying their output for optical recording through galvanometers. Such a set-up, although more expensive, is quite elastic and easily adaptable for work with normals and patients, adults and children, at rest or during maximum ventilatory effort (Figure 1).

In the normal subject, seated, at rest, one of three types of velocity patterns is obtained (Figure 2). In about half of the subjects the pattern is characterized by a roughly dome shaped inspiration and a roughly triangular shaped expiration (Figure 2, top). The significance of this pattern has been explored in the following fashion.

During a normal quiet breath, inspiration is accomplished by contraction of the diaphragm and intercostals (Figure 3). At the end of inspiration the lung elastic fibers have been stretched and are exerting a pull in the expiratory direction greater than the pull of the chest wall elastic fibers in the inspiratory direction. When the inspiratory muscles are relaxed this imbalance in the static elastic forces produces expiratory motion until they are again in balance at which point inspiration is begun.

If one voluntarily forces expiration beyond this balance point and then relaxes, the ensuing inspiration is brought about by the

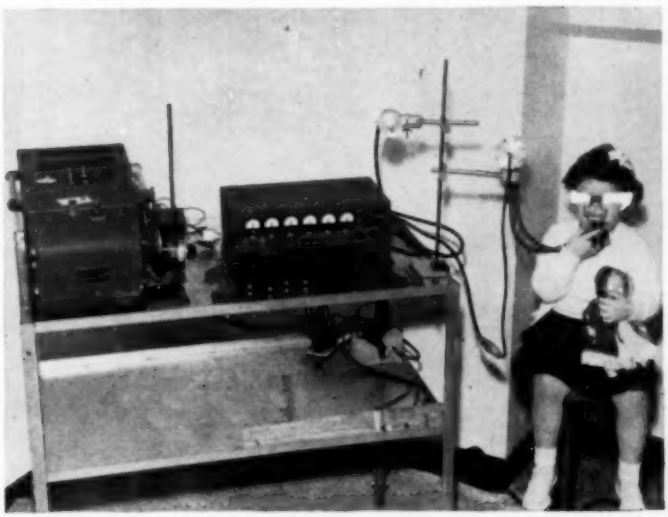


FIGURE 1: Child, with nose clip in place, holding the pneumotachometer attached to standard rubber mouthpiece. Tubing runs from pneumotachometer to differential strain gage manometer. On right side of table is power supply unit and amplifier, and to the left of table is galvanometer oscillograph with camera.

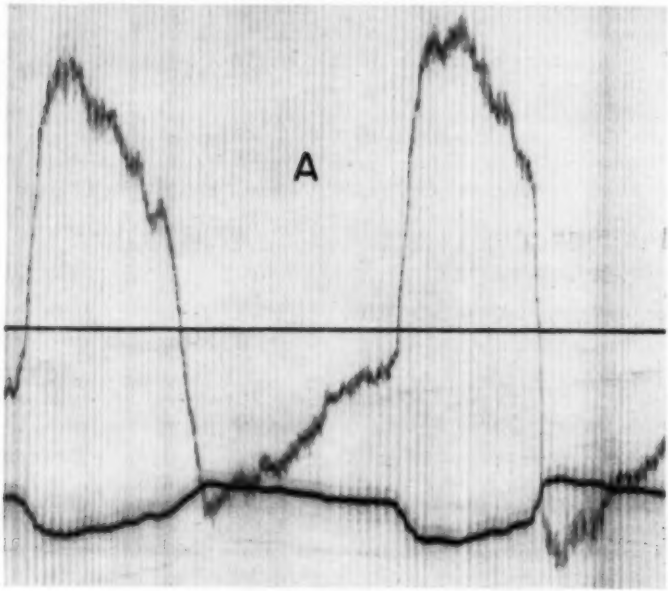


FIGURE 2A

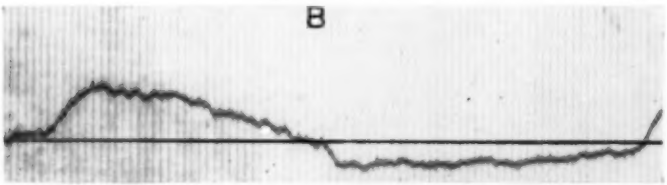


FIGURE 2B

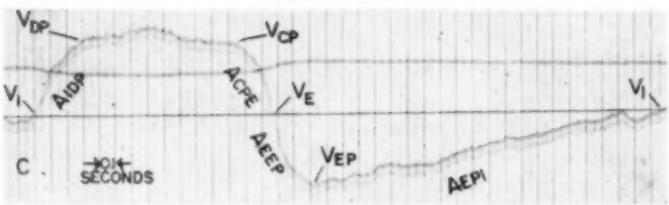


FIGURE 2C

FIGURE 2: C is a pneumotachogram similar to that found in 50 per cent of the normal subjects studied.—A and B are types found equally often in remaining 50 per cent of normals. Inspiration is above the line in each instance. Heavy vertical lines mark 0.1 seconds.

imbalance of the elastic forces now working in an inspiratory direction (Figure 4B). The similarity between the velocity pattern obtained in the normal expiration and in this abnormal inspiration seems to be a clear cut demonstration of the fact that this pattern is a reflection of the forces producing air flow in each circumstance,—that is the elastic forces. Thus one may assume that an expiratory pattern different from this is evidence of some alteration in the relation between the elastic forces and the other forces involved in breathing.

When one takes in a large volume of air during inspiration, thus stretching the lung elastic fibers further, the ensuing expiration begins with a sharper acceleration and the early velocity of air flow is higher, in proportion to the depth of the preceding inspiration (Figure 4A).

In normal circumstances at no point in the resting pattern is there a very sharp acceleration or deceleration of air flow. That is to say that peak velocities are not achieved in less than two

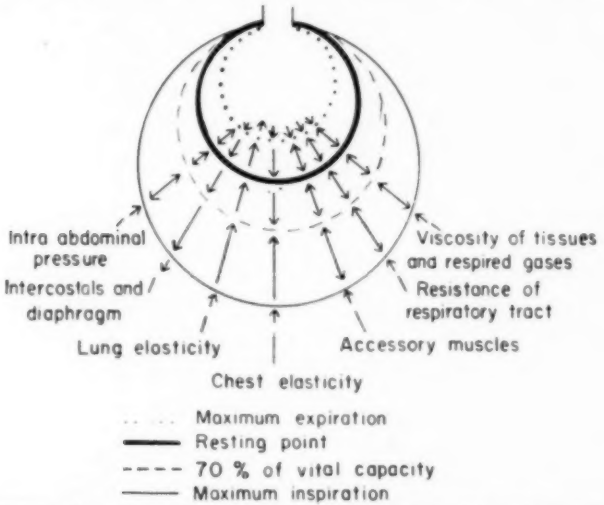


FIGURE 3: Diagramatic illustration of the forces involved in pulmonary ventilation. The viscosity forces and the resistance of the respiratory tract to the passage of gases oppose ventilatory movement in either direction. Lung elasticity always opposes inspiratory movement and assists expiratory movement. The intercostals and diaphragm assist inspiration and offer little or no resistance to expiratory movements. Chest elasticity during quiet breathing assists inspiration and opposes expiration but when the lungs have been inflated to a volume greater than 70 per cent of vital capacity chest elasticity opposes further inflation and assists expiration down to this volume. There is insufficient information as to the relative srtength of these forces but it is known that at the resting point in quiet breathing the force of chest elasticity equally opposes the force of lung elasticity.

or three tenths of a second. When the normal subject is forced to breath against a high added resistance this is no longer the case (Figure 5). Under such circumstances acceleration and deceleration of flow occur rapidly producing a more or less rectangular shaped pattern in both expiration and inspiration. Such a pattern seems to be evidence that the ventilatory effort is encountering resistance which may lie within the airways or in increased viscous resistance in the lung tissue itself.

In the normal subject during inspiration there is commonly a peak of flow velocity early in the phase and a second peak towards the end of the phase (Figure 2C). There is a remarkable similarity between the pneumotachogram of the dog and the normal human and it may be reasonable to apply information gained in

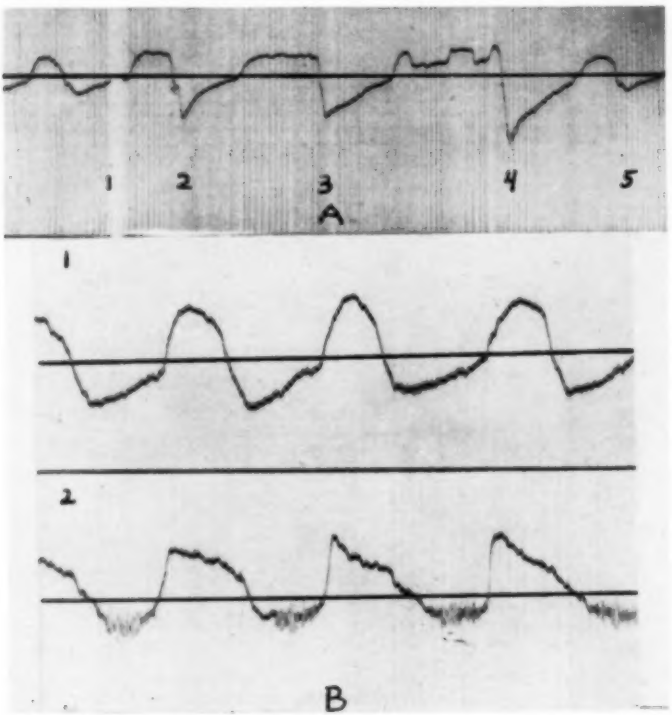


FIGURE 4: (A) Inspiration above zero line, demonstrating increasingly large inspiratory volumes and correspondingly higher initial expiratory velocities. (B) 1. Normal tracing and 2. Inspiration still above line but accomplished by relaxing after forced expiration.

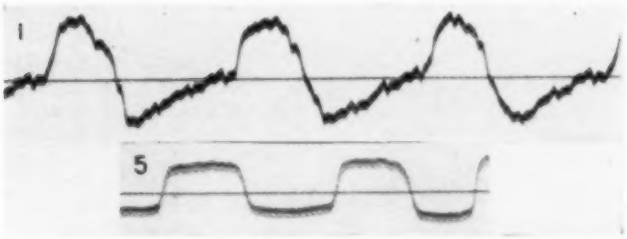


FIGURE 5: Illustrating the change in pattern when increasing resistance is added.

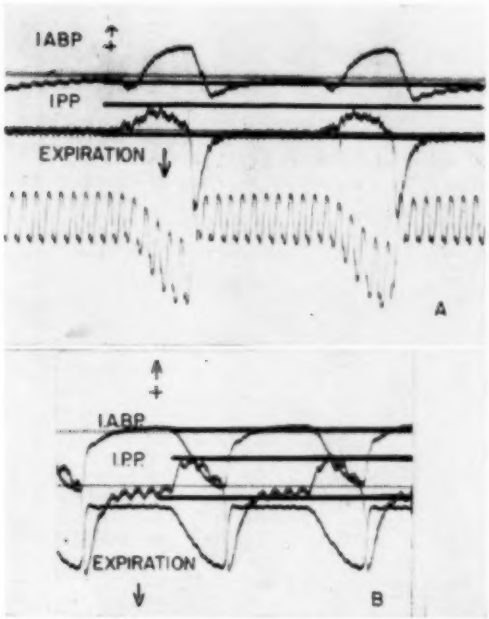


FIGURE 6: (A) Record from a normal dog. Upper tracing (IABP): intraperitoneal pressure; middle tracing: Pneumotachogram; lower tracing: intrapleural pressure. Zero straight lines represent atmospheric pressure and zero flow velocity. The time lines measure 0.1 seconds. Intrapeoneal pressure becomes negative at the onset of inspiration, then positive, and negative again at the onset of expiration. Intrapleural pressure becomes increasingly more negative as inspiration continues, returning to the base-line shortly after the onset of expiration. Large fluctuations in the intrapleural pressure coincide with the heart beat.—(B) Record from the same dog after the phrenic nerves have been severed. Peak flow in the pneumotachogram appears at the onset of inspiration, in contrast to the slow acceleration in figure 1A; velocity during the latter half of inspiration is relatively low. A curve of the intraperitoneal pressure exactly follows that of intrapleural pressure differing only in the degree of pressure change.

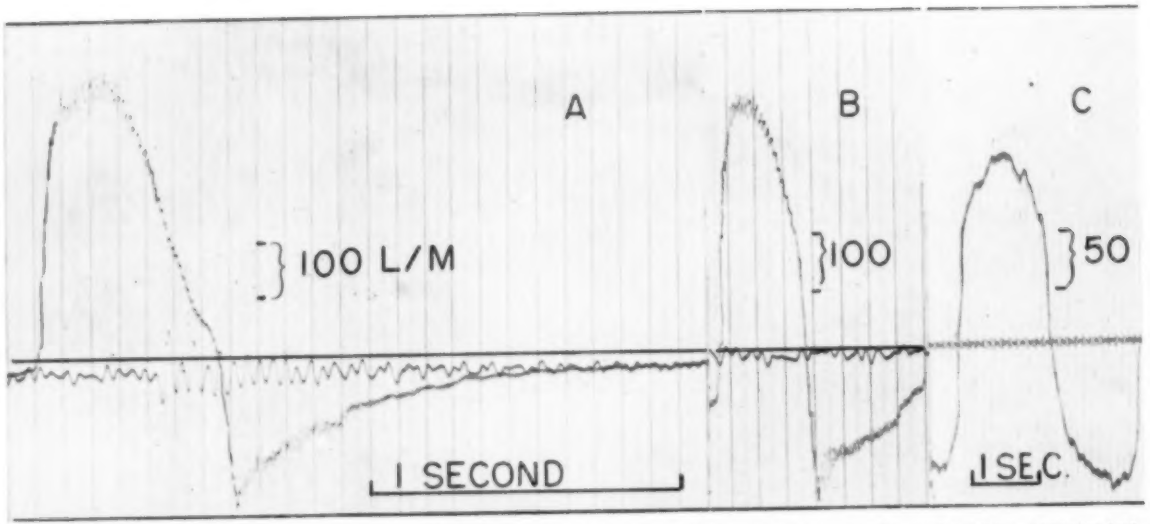


FIGURE 8: From left to right, pattern of a rapid vital capacity (A), pattern during voluntary maximum breathing capacity test using a tidal volume about 50 per cent of vital capacity (B), and pattern of maximum effort resulting from exercise (C). Studies made on a healthy young adult.

experimental work on the dog to the interpretation of this phase of the velocity pattern.[4]

In the dog the early rise in velocity coincides with a fall in the intraperitoneal pressure, and the later peak with a rise in intraperitoneal pressure (Figure 6A). This fact combined with information gained from study of dogs with paralyzed diaphragms and dogs with paralyzed intercostals indicates very strongly that

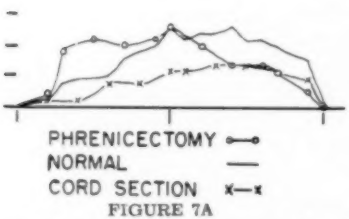


FIGURE 7A

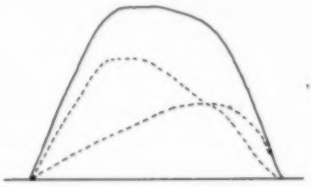


FIGURE 7B

FIGURE 7: (A) This figure shows three inspiratory curves reduced to the same time base (that is, corrected for the difference in respiratory rates in the three animals from which the curves were taken). The curve after phrenicectomy shows peak inspiratory flow earlier in the cycle than in the normal dog. The curve in the spinal dog shows peak flow late in the inspiratory cycle.—(B) The two dotted lines in this figure show two theoretical curves of flow velocity which, when summated, combine to produce the curve shown with a solid line. One curve with peak flow early in inspiration, has the general characteristics of intercostal activity alone, as shown in the phrenicectomized animals. The other with a peak flow in inspiration resembles the inspiratory paterns obtained in spinal animals, where the diaphragms alone expand the lungs. The solid line is taken from an inspiratory pneumotachogram in a normal human.

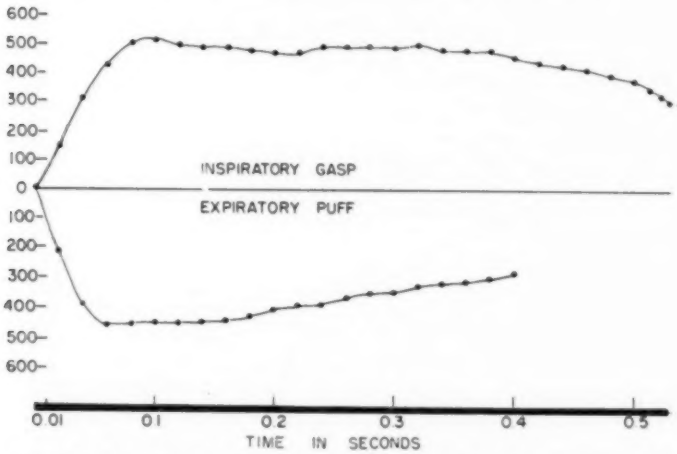


FIGURE 9: Expiratory puff and inspiratory gasp. The rate at which high velocity is reached, and the rate at which deceleration occurs with maximum effort, in a young healthy male.

intercostal activity is largely responsible for the initial rise in inspiratory flow velocity and that the contraction of the diaphragm is responsible for the maintenance of flow velocity in the latter portion of the phase (Figures 6B and 7). Studies in humans have not progressed to the point where one may consider this a certain fact, but, if it is true, one may interpret disproportion between the early and late phases of inspiration as a result of disproportion in the activity of the diaphragm and the intercostals.

Whereas during quiet breathing the normal subject employs peak velocities of 20 to 30 liters per minute, during exercise velocities of 200 liters per minute are readily achieved (Figure

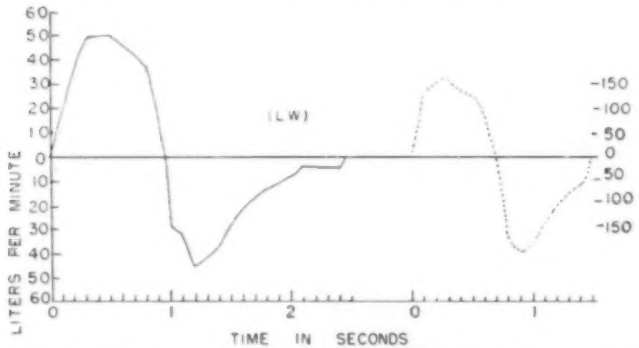


FIGURE 10: L.W., a patient with pulmonary tuberculosis bilateral, cavitation and pneumothorax. Dotted line shows maximum effort.

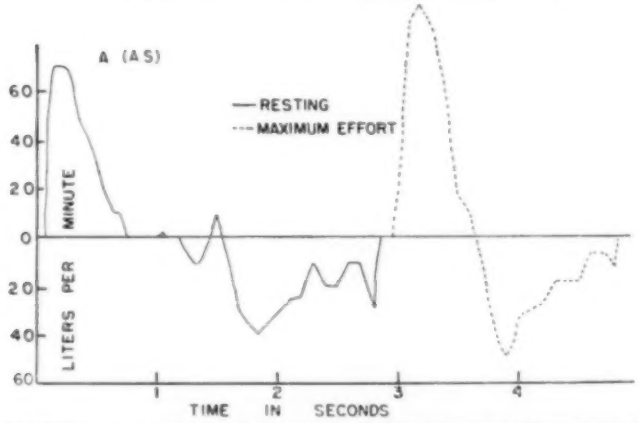


FIGURE 11: A.S., a patient with severe bronchial asthma and bronchiectasis and marked dyspnoea at rest. Maximum effort at right.

8C). When one attempts to voluntarily puff or gasp with great rapidity, velocities of 600 liters per minute can be reached in one to two tenths of a second (Figure 9). In all normal subjects high rates of ventilation are achieved by use of a velocity pattern characterized by very rapid accelerations and decelerations and only brief maintenance of high flow velocities (Figure 8B). It is only when the normal subject attempts to perform a rapid vital capacity that more gradual deceleration of flow velocity occurs, especially during expiration (Figure 8A). Tidals less than the vital capacity volume are employed by the normal subject in producing his best ventilatory rates.

The following conclusions have been drawn from study of normal subjects:

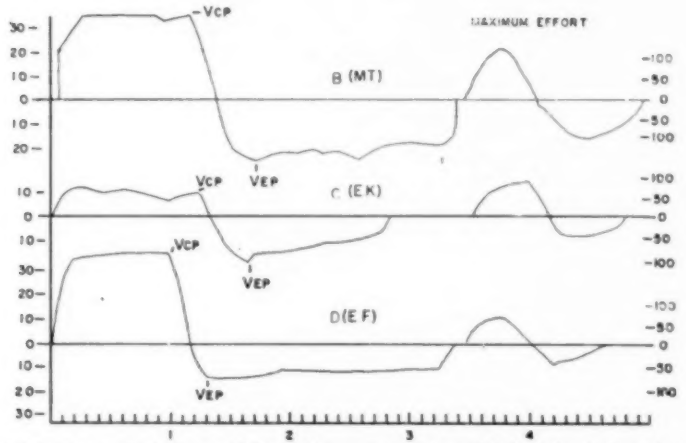


FIGURE 12: (B) M.T., a middle aged woman with bronchiectasis in all five lobes.
(C) E.K., an adolescent girl with bilateral bronchiectasis.
(D) E.P., a young woman with multilobar bronchiectasis.

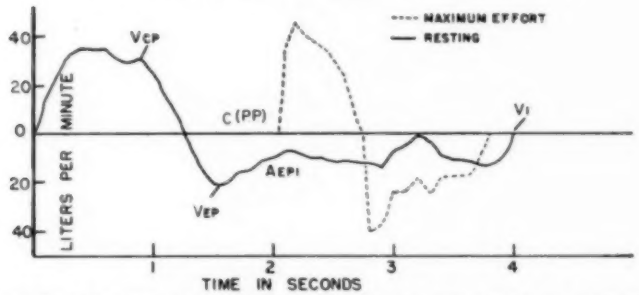


FIGURE 13: P.P., a man with pulmonary emphysema and chronic cor pulmonale.

1) Certain characteristics are common to the resting pneumotachograms of most normal subjects.

2) It may be possible to interpret the inspiratory phase as a reflection of early intercostal activity and later diaphragmatic activity.

3) Any deviation from the triangular shaped expiration with peak velocity early in the phase may be interpreted as an indication of abnormal interaction between the elastic forces and the other respiratory forces.

4) The normal subject is capable of velocities more than 10 times those he employs at rest.

5) The pattern of flow velocity during maximum ventilation is roughly triangular in shape with very rapid acceleration and deceleration.

A few examples of air flow studies in patients with pulmonary disease may serve to point out the usefulness of the pneumotachogram in the study of pulmonary ventilation.

L.W. is a young woman with bilateral pulmonary tuberculosis. At the time of study there was therapeutic pneumothorax on the left and an open cavity in the right lung (Figure 10). She had a normal resting pneumotachogram and was able to reach velocities of 150 to 200 liters per minute during voluntary maximum effort. Expiration was only very slightly prolonged during maximum effort. Spirometric studies demonstrated a maximum breathing capacity of 70 liters per minute with a ventilatory reserve of over 90 per cent. From the point of view of her ventilatory ability she was considered a perfectly safe risk for further collapse therapy or resection.

A.S. was a young woman with long standing severe bronchiectasis and asthma. Her resting pneumotachogram (Figure 11) showed severe abnormalities indicating ineffective use of the inspiratory musculature and severely impaired pulmonary elasticity. With maximum effort she was

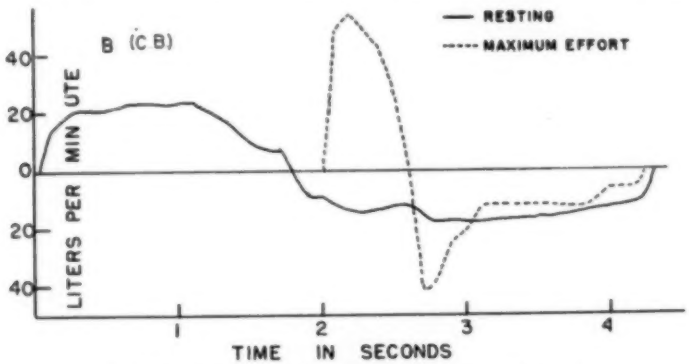


FIGURE 14: C.B., a patient with pulmonary emphysema.

unable to produce significantly greater velocities than those used at rest. She died on the table during an attempt to resect her bronchiectasis.

One of the most common pathological forms of pneumotachogram is illustrated by a middle aged woman (M.T.) with severe multilobar bronchiectasis (Figure 12B). The rectangular shape of the resting pattern is indicative of severe resistance to respiratory effort. In patients with bronchiectasis this is thought to be attributable to increased lung viscosity rather than to airway resistance.

P.P. was an elderly man with severe emphysema and cor pulmonale (Figure 13). Severe impairment in pulmonary elasticity is indicated by the shape of the expiratory pattern and the prolongation of this phase. He died of right side heart failure within six months of this study.

C.B. is a middle aged man with pulmonary emphysema and a markedly reduced ventilatory reserve (Figure 14). With maximum effort he is unable to reach peak velocities as high as 100 liters per minute, and the time required for inspiration is only one-third that needed for expiration. Such a patient would certainly benefit from respiratory exercises directed at improvement in the expiratory phase.

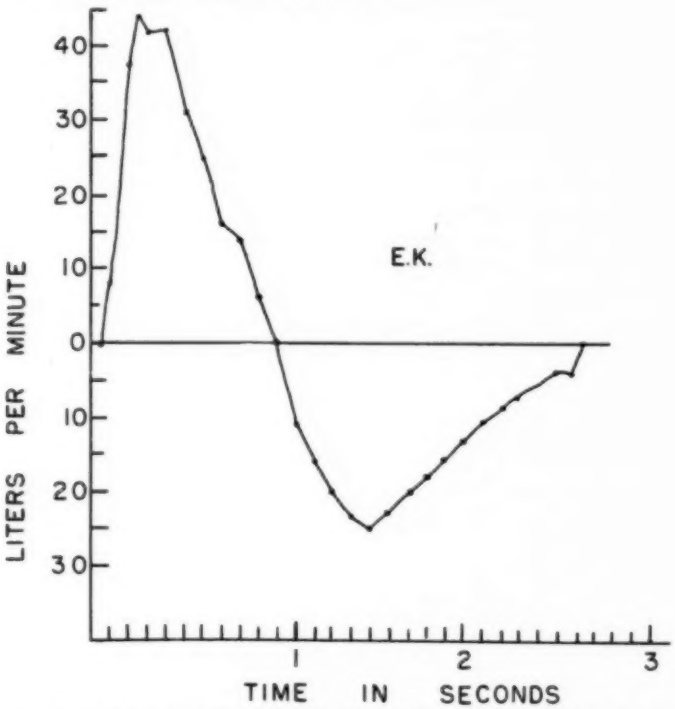


FIGURE 15: E.K.. Inspiration above the line. Note sudden acceleration at onset of inspiration but poor maintenance of velocity during this phase.

E.K. is a young woman with severe asthma on a functional basis (Figure 15). Her resting inspiratory pattern shows a sudden rise to peak velocity but poor maintenance of this velocity with rapid return to zero. During such attacks almost all of her respiratory effort was made with the upper chest, the diaphragm probably being held in spasmodic contraction.

SUMMARY

The pneumotachogram is a record obtained quickly and easily with apparatus offering only negligible resistance to breathing.

It yields information in regard to the characteristics of resting ventilation and ventilation during maximum effort.

It is possible to interpret the record in terms of some of the deficiencies in the respiratory apparatus probably accounting for reduced ventilatory function.

As in the electrocardiogram, the pneumotachogram is best interpreted in connection with the information gained from history, physical and other functional studies.

RESUMEN

El neumotacograma es un registro obtenido rápida y fácilmente con aparatos que ofrecen solo ligera resistencia a la respiración.

Proporciona información de las características de la ventilación durante el reposo y de la ventilación durante los esfuerzos máximos.

Es posible interpretar el registro en terminos de algunas deficiencias en el aparato respiratorio que probablemente expliquen la reducción de la función ventilatoria.

Como el electrocardiograma, el neumotacograma es interpretado mejor en conexión con la información obtenida por la historia clinica, examen fisico y otros estudios funcionales.

RESUME

Le pneumotachogramme est un enregistrement qui peut être obtenu rapidement et facilement avec un appareil qui n'ofrre qu'une résistance négligeable à la respiration. Il donne des renseignements sur l'air résiduel et sur la ventilation au cours de l'effort maximum.

Il est possible d'interpréter l'enregistrement en fonction de déficiences de l'appareil respiratoire vraisemblablement causées par la réduction de la ventilation.

De même que l'électrocardiogramme, le pneumotachogramme doit être interprété de préférence selon les renseignements obtenus par l'étude de l'histoire de la maladie, de l'examen physique et de l'état des autres organes.

REFERENCES

1 Proctor, D. F. and Hardy, J. B.: "Studies of Respiratory Air Flow: I. Significance of the Normal Pneumotachogram," *Bull. Johns Hopkins Hosp.*, 85:253, 1949.
2 Proctor, D. F., Hardy, J. B. and McLean, R.: "Studies of Respiratory Air Flow: II. Observations on Patients with Pulmonary Disease," *Bull. Johns Hopkins Hosp.*, 87:225, 1950.
3 Proctor, D. F., Isaacs, J. P. and Carter, B. N.: "The Production of Maximum Ventilation and Its Limitation in Pulmonary Disease," *Surgical Forum*, W. B. Saunders Co., pp. 7-13, October 1950.
3 Woods, A. C. Jr., Proctor, D. F., Isaacs, J. P. and Carter, B. N.: "Studies of Respiratory Air Flow: III. The Mechanics of Respiration as Reflected by Changes in Intraperitoneal Pressure," *Bull. Johns Hopkins Hosp.*, 88:291, 1951.
5 Fleisch, A.: "Der Pneumotachograph: ein Apparat zur Geschwindigkeitsregisterierung der Atemluft," *Pfluger's Arch. f. d. ges. Physiol.*, 209:713, 1925.
6 Bretschger, H. J.: "Die Geschwindigkeitskurve der menschlichen Atemluft," *Pfluger's Arch. f. d. ges. Physiol.*, 210:134, 1925.
7 Gukelberger, N.: "Zur Analyse des Pneumotachograms zur Dynamik der Atembewegung unter Normalen Bedingungen," *Zeits. f. d. ges. Exp. Med.*, 113:737, 1944.
8 Silverman, L., Lee, R. C. and Drinker, C. K.: "A New Method for Studying Breathing, with Observations Upon Normal and Abnormal Subjects," *J. Clin. Invest.*, 23:907, 1944.
9 Silverman, L.: "Respiratory Air Flow Characteristics and Their Relation to Certain Lung Conditions Occurring in Industry," *Jour. Indiana Hyg. and To.*, 28:183, 1946.
10 Kay, R., Whittenberger, J. L., Silverman, L.: "Respiratory Air Flow Pattern in Children," *Am. J. Diseases of Children*, 155:625, 1949.
11 Neergaard, K. V. and Wriz, K.: "Die Messung der Stromungswiderstande in den Atemwegen des Menschen, insbesondere bei Asthma und Emphysem," *Zeitschr. Klin. Med.*, 105:42, 1927.

Discussion

GEORGE R. MENEELY, M.D., F.C.C.P.
Nashville, Tennessee

The pneumotachograph has intrigued pulmonary physiologists since the method was first conceived. I recall, while I was in training, Dr. William S. McCann predicting that the pneumotachygram might some day come to have the importance in diseases of the respiratory apparatus that the electrocardiogram has gained in diseases of the heart.

The manner in which a patient breaths has always been recognized as an important diagnostic fact. From earliest days, by the method of inspection and auscultation, the clinician has recognized characteristic alterations in inspiration and expiration and has correlated these with underlying pathological changes. Precise measurement of alterations in the velocity of inspiration and expiration enhance the opportunity of the clinician to characterize the manner of breathing because these velocities depend intimately upon the underlying forces and counterforces at work in respiration.

The pneumotachygraph presented, at first, difficult technical problems: How to measure the velocity of air exchange without impeding it? These technical problems seem now to have been solved. There remains the difficult problem of tying up the velocity patterns with alterations in the living function of the respiratory apparatus. We cannot anticipate a complete and early definition nor should we. Kolliker and Müller a century ago showed electricity associated with heart action. Waller first recorded the human electrocardiogram in 1887. Almost 50 years ago, in 1903, Einthoven introduced the string galvanometer replacing the capillary electrometer and, since then, technically precise electrocardiagrams have been obtained with relative ease. Yet, half a century later, each year unfolds new mysteries in our understanding of these deflections.

So it must be with the pneumotachygraph. The confusions must be peeled back, layer by layer, until we come to a widely useful understanding of the respiratory process. Dr. Proctor, with others working in this field, has " . . . touched the hem of nature's shift . . . " and these contributions to the relation of the velocity of the breath to the function of breathing has helped " . . . uplift that closest all concealing garment."

Of particular importance is Dr. Proctor's reference to the viscous property. All engineering problems in human mechanics must take account of this because it is in the nature of flesh to be viscous-elastic rather than purely elastic. All protoplasm exhibits the variable viscosity of a non-Newtonian fluid. Flesh is *quasi-viscous*, or *plastic*, in the nomenclature of *Rheology*. In the past we have learned a good deal about the elastic property of the respiratory process. More attention must be paid to the viscous property.

Experience with Putrid Lung Abscess in Negro Patients

RICHARD A. S. CORY, M.B., Ch.B., M.R.C.S., L.R.C.P., F.C.C.P.*
Jamaica, British West Indies

During the last 10 years 62 cases of putrid abscess of the lung in Negro patients have been treated in the King George V Jubilee Memorial Sanatorium, Jamaica, British West Indies.

Aetiologically our patients have not appeared to differ in any material respect from the usually accepted belief that infection occurs in an atelectatic area of lung, and that the putridity characteristic of the disease follows the advent of anaerobic organisms.

We have not been able on the evidence presented by these cases to subscribe to the importance of vascular embolism via the pulmonary arterial system, and are firmly convinced that the condition in by far the majority of individuals arises as the result of inhalation of infected material from the upper respiratory passages.

Most of us inhale some saliva or nasal secretion during sleep. Without pulmonary atelectasis, and in the absence of relatively thick or solid particles in the inhaled material we escape lung abscess. Atelectasis alone will not cause an abscess, nor as a rule will the simple inhalation of organisms. When the two occur together however pulmonary abscess of the putrid type may develop.

Following abdominal surgery the perfect set up is present. Inadequate diaphragmatic movement with poor aeration of the pulmonary bases paves the way for retention of bronchial secretions, and subsequently areas of lobular or even segmental atelectasis are likely to appear. If to this is added the inhalation of saliva or infective material from a dirty mouth, either during anaesthesia, or in the narcotic sleep following surgery, the patient is a candidate for abscess.

One of our patients fell off a tree, hitting his head and becoming unconscious for two hours. His mouth was full of the most horrible stumps. In four weeks he had a putrid abscess cavity the size of a small orange.

Another patient ruptured a peritonsillar abscess spontaneously, and in less than a month was coughing up fetid pus from a sizeable cavity in his lung.

It is not necessary to blame an imperfectly functioning dia-

*Senior Medical Officer, King George V Jubilee Memorial Sanatorium, Liguanea, Jamaica, British West Indies.

phragm in many of the cases, as very often the material inhaled is quite thick enough to bring on some atelectasis by virtue of the bronchial blocking its own consistency occasions. This is particularly noticeable where coma or a deep sleep, such as that caused by an anaesthetic or an alcoholic bout, may have depressed the cough reflex.

An inhaled extraneous foreign body may by its shape produce bronchial blockage and subsequent abscess, and we have repeatedly noted bronchoscopic foetor of the breath when removing bronchial foreign bodies, even within a few days of aspiration. It is worthy of mention however that no abscess in our series could be ascribed to foreign body aspiration, and all the long-sojourn foreign bodies we have had to handle have presented as bronchiectasis and not abscess.

The old view—still quoted in text-books—that the lower lobe is the commonest site of abscess seems to require modification. It has been our experience that upper lobe infections are at least twice as common as those found in the lower zones.

Of our first 30 cases 20 occurred in the upper lobes, nine in the lower lobes and only one in the middle lobe.

This is quite understandable on the basis of an aspirational aetiology, the aspiration probably taking place during sleep when the bronchial orifice to an upper lobe is particularly vulnerable. Brock[1] has pointed out this fact, and has coined the term "bronchial embolism" for the aspirational process. He describes certain areas in the upper lobes as being specially subject to infection as they are fed by segmental bronchi which carry pus directly to them when aspiration occurs in a patient who is asleep, and particularly when he is lying on his side. Our experience has served to strengthen our belief in this view.

Whatever the site of the abscess however, its basic pathological pattern remains the same. It is an anaerobic necrosis in a peripherally located area of lung. Neuhoff[2] has emphasized the fact of this peripheral location, and has pointed out that an appreciation of it is basic to the surgical drainage of early abscesses.

In this respect there is no reason to believe that the Negro patient differs in any way from his white counterpart. Peripheral location however, while a help to the surgeon, may be a hindrance to the patient, as it so often means that adequate spontaneous drainage via a bronchus cannot occur, as bronchi near the periphery of the lung are small, and easily occluded by slough and debris.

If a slough of solid tissue is present it cannot as a rule be evacuated through a bronchus, and it will perpetuate the infection until the cavity becomes fibrotic and chronic.

Cavities which do not evacuate early and thoroughly tend to spread in size, involving surrounding areas of lung, and leading to daughter cavities, often communicating by quite small openings with the original excavation. Such a complex system will seldom, if ever, respond to medical treatment, and is an equal bugbear to the surgeon who finds great difficulty in establishing adequate drainage of the area involved.

Even with an apparently good result from treatment the bronchial walls have been so damaged and eroded that permanent bronchiectasis is likely to result. This is too often what happens when medical treatment has been ineffectual, and surgical drainage has been too long delayed.

An abscess cavity with partial drainage and thickened wall may persist for years, with the patient not well, but not exactly ill. He goes through life expectorating purulent sputum which on occasions may be putrid, and he lives under the shadow of a metastatic cerebral abscess, or further pulmonary damage.

The problem of diagnosis seems to us to differ not at all when Negro patients are compared with white ones. Pain at the site of the lesion has been a constant symptom with our cases, even though it may have disappeared by the time they reach us. In many however, it continues for weeks after the onset of disease, and on numerous occasions has proved an extremely accurate aid to localization.

The typical symptom, the sudden expectoration of a large amount of putrid pus, is by no means constant, and our records suggest that it has occurred in less than half the cases.

Its absence may lull the unwary physician into a false sense of security, and in the meantime the cavity continues to enlarge, its presence quite unsuspected. This is even more likely to occur when drainage has permitted aeration of the diseased area and the typical putridity has abated. These are the cases that so often find their way into tuberculosis wards or hospitals when further time is lost while sputum concentrates and cultures are being undertaken. During this period pericavitary spread or fibrosis continue, and bronchial damage paves the way to future bronchiectasis. In fact the chances of cure by any but extirpative surgery become increasingly more remote.

Our experiences with diagnosis on the results of physical examination have been extremely disappointing, as signs have been few and indefinite, and in any case they can never provide a differential diagnosis. A clear cut history, if obtainable, and one sniff at the sputum-cap, or of the patient's breath, are as a rule far more useful for diagnostic purposes than half an hour with the stethoscope.

The importance of radiology in diagnosis needs no emphasis, but in this connection it should be stressed that a good lateral film appears to be of much greater value in localization than any of the obliques—when it is viewed in association with the standard P. A. exposure. One of the most important features of the x-ray film is its value in enabling one to assess the stage to which the pathology has progressed, thus providing a useful guide to the type of treatment that is likely to be demanded.

A small infiltrative focus without much excavation for instance may respond well to general medical and intensive antibiotic therapy, while a large or poorly drained cavity may indicate the need for early surgery.

Work by Brock[3] and Foster-Carter[4] has revealed a great deal of new information about the various broncho-pulmonary segments, and their relation to abscess formation, and if adequate surgery or postural drainage is to be undertaken this knowledge is vital to success.

We routinely bronchoscope our cases in order to avoid overlooking a growth or foreign body, but it must be admitted that with a few exceptions the procedure has helped but little in diagnosis or localization, and only very seldom in treatment. Early post-tonsillectomic abscesses however, may do extremely well following even a single bronchoscopy with aspiration of the bronchus leading to the area involved.

In considering diagnostic features it is worth remembering that many years ago Burrell[5] pointed out that a persistently purulent sputum that is negative for tubercle bacilli does not come from a tuberculous lesion.

In this connection however, the possible presence of non-pathogenic acid-fast organisms in lung abscess patients was emphasized by Cory[6] who reported two cases where their presence caused considerable confusion in the early stages of diagnosis and treatment.

It is in just this type of patient that a carefully taken history—and above all the odour of the sputum—may point at once to the correct diagnosis, regardless of the report of acid-fast bacilli in the sputum.

Treatment of putrid lung abscess is still by no means as satisfactory as could be desired, and it is to be regretted that our results in Negro patients only serve to confirm this.

We do not as a rule receive our cases at a really early stage, and with few exceptions they have well developed cavities before they are sent to us. This naturally does not tend to improve results, as we are really treating what are tantamount to late, or at least post-acute cases.

It is our custom however, to attempt by x-ray films to assess

the stage of the pathology in terms of what we believe has happened, or is happening, in the lung rather than to adhere to a time division into acute and chronic categories. An "infiltrative" process, or a thin walled cavity that has only just undergone evacuation of its contents is regarded as an "early" case, whereas one that is revealed as having something of a fibrous or atelectatic reaction around it falls into the "late" group.

A cavity that is complicated by daughter cavities is definitely a "late" development, though in terms of time such a state of affairs may be found within a few weeks of onset.

We treat "early" cases—when we get them—by medical means, including bronchoscopic aspiration, and our results suggest that about two cases out of three will respond favorably and clear up.

Frequent x-ray films however, are taken, sometimes every three or four days, so that we may be in a position to discard unsuccessful therapy as soon as improvement ceases, or deterioration sets in.

Jackson and Rudd[7] have pointed out the value of bronchoscopy in early cases, but our experience has been that it must be undertaken for best results even before a cavity has made its appearance. In late cases it has seldom, in our hands, brought about a cure, though it may help to improve the patient's general condition.

Our late cases have seldom shown any really favorable response to penicillin in doses of half a million units a day, and we now employ it more as a preparation for surgery than as a means of treatment. We have had no experience with the newer antibiotics in lung abscess.

The best plan we feel is to discard medical treatment the moment it becomes evident that it is not getting the patient anywhere. Further delay is dangerous, and will only make the result of surgery that much more uncertain when finally the case comes to operation.

In our experience an indication for immediate surgical drainage has been the cavity—even though small—with a large dense area of hazing around it. This represents diseased and oedematous lung, and will as a rule only clear, and then very slowly, when adequate external drainage has been established.

In these cases extensive vascular thromboses prohibit natural attempts at repair, and to a large extent militate against the successful use of drugs or antibiotics that must be carried to the tissues in the bloodstream.

Transthoracic drainage has been the method of choice for many years in the treatment of lung abscess, but its success depends to a very large extent upon when it is used.

Kross[8] entered a plea seven years ago for primary lobectomy in the old chronic fibrotic cavities, and Lindskog[9] wrote even

before this on the same subject, urging that standard drainage procedures were not always satisfactory, and pointing out that they should in some cases be replaced by resection.

Admittedly, some of these cases do well if the drainage opening is kept widely patent for a long enough time. More often however, a large well drained cavity merely becomes epithelialized without any marked reduction in size. In other patients the main cavities virtually disappear, but permanent broncho-cutaneous communications remain, and these have to be closed by plastic procedures.

In others permanent pulmonary cavities have finally to be filled with muscle grafts. None of this is really satisfactory, and we feel that muscle grafts never really obliterate the space, but inevitably leave little nooks and crannies that ultimately lead to bronchiectasis. Franklin[10] after bronchographic studies of healed abscesses has been able to demonstrate the occurrence of much residual bronchiectasis which often goes quite unsuspected either by the patient or his physician.

Drainage techniques have improved considerably in the last 15 years, and Neuhoff[11] has written strongly on early operation. This view has gained wide acceptance, but the problem still remains that a large number of cases are not referred for surgery until far too late for first class results by any drainage method yet described.

No good purpose could be served by a discussion of surgical technique as it is too well known to require comment. There are however, one or two points that might bear consideration, and they are presented as they have arisen on more than one occasion in our series of cases. The first concerns the apparent paradox of the difficulty of accurate localization of the area of adhesions in the really large cavity. Pleural adhesions form early over an area under which the disease lies. When the patch of disease in the lung is not extensive it is possible to localize this adherent area with great accuracy, and as a result a one stage operation is the rule.

Our problem however, has been the large cavity which has eroded the lung far beyond the overlying area of adhesions. How can one tell when looking at an x-ray film showing four or five square inches of cavity just where the adherent safe zone lies? That the whole area is not adherent we have demonstrated more than once by entering a free pleural space, only to find a safely adherent zone half an inch away. We know of no method of determining in these large cavity cases just which part is adherent, and we now content ourselves with aiming for what should be the central area.

If we open free pleura a finger passed inside gives the exact

location of the safe zone, and we open in the new site after the original pleural incision has been closed and packed off. If this is done carefully, and the abscess cavity is thoroughly emptied by suction when only a small preliminary opening has been made into it, the danger of pleural soilage is negligible, and a standard two-stage procedure need not be employed. Theoretically it would be possible by preoperative exploration of the proposed site with a needle connected to a pneumothorax apparatus to determine the location of the adhesions, but this method has never commended itself to us, and we have not employed it.

Seven of our lung abscess cases have presented as putrid empyemata which followed intrapleural rupture. Much has been written on drainage techniques in this condition, and ingenious one-way valvular drains have been described which permit egress of pus but no ingress of air. We have adopted a simple technique, which in all seven cases proved extremely satisfactory.

About six inches of the eighth or ninth rib is resected posterolaterally and the pleura is opened throughout practically the whole length of this incision. All pus is removed from the pleural cavity by aspiration, and three or more yards of four inch gauze is introduced loosely into the pleural cavity, one end being left outside the wound, to the edge of which it is secured with a stitch. No attempt is made to close the wound in the chest wall and dressings are merely applied over it.

The patient is turned over on his wound so that drainage is completely free and dependent. He is nursed in this position without any change of pack for three or four days. Adequate drainage is permitted, and as the good lung is kept uppermost all the time there is no significant mediastinal shift, and dyspnoea is entirely lacking.

Further treatment depends upon what happens to the primary abscess. Sometimes it closes after its rupture, but at other times secondary drainage or resection may be needed later. All the cases we have treated by this method recovered completely from empyemata, but two of them required further surgery for residual abscesses, and of the others one died of a brain abscess after the empyema had become obliterated.

Despite what can be done by drainage in early abscesses the modern trend is rather towards resection in the advanced fibrotic cases, and it seems only rational that when a large portion of a lobe has been destroyed beyond all hope of recovery it should be removed.

Abscesses in children in this series have tended to overstep the lobar bounds more readily than those in adults, and as a result we found that of the four children on whom lobectomy was proposed,

three of them required pneumonectomy on account of the extent of involvement found at operation.

Medical treatment appears to be justified in early cases, but it must be discontinued in favor of surgery as soon as it is determined that the patient is not responding favorably.

The form of surgery that should be used will again depend upon the pathology present. Reasonably early cavities will respond to adequate drainage, but old, thick walled, or complicated ones are probably better handled by resection.

ANALYSIS OF RESULTS IN 62 CASES OF PUTRID LUNG ABSCESS IN NEGRO PATIENTS

	Men	*Women and Children*
Number of cases	51	11
Totals, Both Sexes: 62 (100 per cent).		
Treated surgically	32	8
Totals, Both Sexes: 40 (64.5 per cent).		
Surgical, cure	21	6
Totals, Both Sexes: 27 (67.5 per cent of those treated surgically. 43.5 per cent of total cases).		
Surgical, unchanged	4	
Totals, Both Sexes: 4 (12.5 per cent of those treated surgically. 6.4 per cent of total cases).		
Surgical, dead	7	2
Totals, Both Sexes: 9 (28 per cent of those treated surgically.		
Treated medically	19	3
Totals, Both Sexes: 22 (35.5 per cent).		
Medical, cure	12	2
Totals, Both Sexes: 14 (63.6 per cent of those treated medically. 22 per cent of total cases).		
Medical, unchanged	2	
Totals, Both Sexes: 2 (9 per cent of those treated medically. 3 per cent of total cases).		
Medical, dead	5	1
Totals, Both Sexes: 6 (27 per cent of those treated medically).		

OVERALL TOTALS

(Medical and Surgical Figures Combined)

Number of Cases	62 = 100 per cent
Cured	41 = 66.1 per cent
Living but with unclosed cavity	6 = 9.6 per cent
Dead	15 = 24.2 per cent

Of our cases, those that recovered on medical treatment averaged a hospital stay of 95 days, while those treated by drainage, and recovering, averaged a stay of 196 days, just over twice as long.

Resection cases (four children) were all fit to leave the hospital in 25 days, though we kept them rather longer on account of their poor home conditions.

SUMMARY

Based on a series of 62 cases, an account is given of experience gained with treatment of putrid lung abscess in Negro patients in a hospital in Jamaica, British West Indies.

Most patients are found on admission to have passed the early stage when bronchoscopy, antibiotic treatment and chemotherapy would have their greatest value.

Aetiological and Pathologic factors have been briefly reviewed, and the importance of aspiration of infective material, and "bronchial embolism" have been stressed.

Surgical drainage has been touched upon, and primary resection has been suggested as the probable future treatment of choice in the case of the late, tough walled cavity.

A simple, but so far satisfactory method of dealing with acute fulminating putrid empyema has been described.

A brief table has been given to illustrate what results have been obtained on the patients in this series.

Of all cases, approximately two-thirds appear to have been cured, while one-quarter or a little less have died.

With drainage one in 10 have failed to close their cavities, and though they have lived they are not cured.

Seven cases of putrid empyema all recovered from their empyemata, though two required further surgery for their abscesses, and one of the others died later of a brain abscess.

This was the only brain abscess in the series.

Four children were treated by resection, and they all did well.

Hospital stay in the cured surgical drainage cases was twice as long as those cured by medical measures.

Resection cases spent the least time in the hospital.

RESUMEN

Se informa acerca de la experiencia que, basada en una serie de 62 casos, fué adquirida en el tratamiento de abscesospútridos del pulmón en pacientes negros en un hospital de Jamaica, Antillas Británicas.

Se encuentra que la mayoría de los enfermos, al ser admitidos, ya pasaron la fase temprana, durante la cual tendrían el mayor valor la broncoscopía, el tratamiento antibiótico y la quimioterapia.

Se repasan brevemente los factores etiológicos y patológicos, y se subraya la importancia de la aspiración de material infectante, y del "émbolo bronquial."

Se habla de la canalización quirúrgica y se sugiere la resección primaria como el tratamiento que probablemente se elija en el futuro para un caso de cavidad tardía, de la cavidad de paredes gruesas.

Se describe un método sencillo pero hasta ahora satisfactorio para tratar el empiema pútrido fulminante.

Se presenta un cuadro breve para señalar qué resultados se han obtenido en los enfermos de esta serie.

De todos los casos, aproximadamente dos tercios parecen haber sido curados, en tanto que un cuarto o poco menos murieron.

Con la canalización, uno de cada diez no cerraron sus cavidades y aunque sobreviven no han curado.

Siete casos de empiema pútrido se recuperaron del todo de su empiema aunque después requirieron otros procedimientos quirúrgicos para los abscesos, y uno de los otros murió después, de absceso cerebral. Este fué el único absceso cerebral en la serie.

Cuatro niños se trataron con resección y evolucionaron bien.

La estancia en el hospital en los casos de canalización que curaron fué el doble de la de los tratados médicamente.

Los casos de resección estuvieron en el hospital el tiempo menor.

RESUME

L'auteur décrit son expérience du traitement des abcès putrides du poumon chez les Noirs. Cette expérience est basée sur une série de 62 cas observés dans un hôpital de la Jamaïque.

La plupart des patients se présentent à l'admission au-delà de la première étape dans laquelle la bronchoscopie, le traitement par antibiotiques, et la chimiothérapie pourraient avoir leur plus grande activité.

L'auteur, passant rapidement en revue les facteurs étiologiques, et anatomiques, insiste sur l'importance de l'inhalation de produits septiques, et sur les embolies bronchiques. Il esquisse la question du drainage chirurgical, et admet que la résection sera vraisemblablement dans l'avenir le traitement de choix lorsqu'il s'agit de cavernes anciennes, et à parois rigides.

Il décrit la conduite à tenir, simple mais jusqu'à présent satisfaisante, en présence de pleurésies putrides suraiguës. Un tableau rapide illustre les résultats obtenus sur de tels malades. De tous les cas, environ les deuxtiers ont été guéris alors qu'il n'y a eu qu'un quart ou un peu moins de décès.

Par le drainage, chez un malade sur dix on n'obtint pas la fer-

meture des cavités, et bien qu'ils survécurent, on ne peut les considérer comme guéris.

Sept cas d'empyème putride guérirent tous de leur pleurésie, bien que deux d'entre eux durent être opérés ultérieurement pour leur abcès, et qu'un des autres finit par mourir plus tard d'une localisation cérébrale.

Ce fut le seul cas d'abcès du cerveau constaté dans cette série.

Quatre enfants furent traités par exérèse avec les meilleurs résultats. Le séjour à l'Hôpital des malades traités par drainage chirurgical fut deux fois moins long que pour ceux qui furent traités médicalement. C'est dans les cas d'exérèse que le séjour à d'Hôpital fut le plus court.

REFERENCES

1 Brock, R. C., Hodgkiss, F. and Jones, H. O.: "In Relation to Bronchial Embolism and Posture," *Guy's Hospital Reports*, 91:131, 1942.
2 Neuhoff, H.: "Surgical Treatment of Acute Abscess," *Dis. of Chest*, 7:74, 1941.
3 Brock, R. C.: "Anatomy of the Bronchial Tree," *Oxford University Press*, 1947.
4 Foster-Carter, A. F.: "Anatomy of Bronchial Tree," *British J. Tuberc.*, 36:19, 1942.
5 Burrell, L. S. T.: "Recent Advances in Pulmonary Tuberculosis," *J. and A.*, Churchill, London, 1931.
6 Cory, R. A. S.: "Acid Fast Bacilli in Non Tuberculous Pulmonary Disease," *Am. Rev. Tuberc.*, 52:36, 1945.
7 Jackson, C. L. and Rudd, H. R.: "Role of Bronchoscopy in the Treatment of Pulmonary Abscess," *J. Thoracic Surg.*, 10:179, 1940.
8 Kross, I.: "Chronic Abscess Treated by Lobectomy as Method of Choice," *Am. J. Surg.*, 62:277, 1943.
9 Lindskog, G. E.: "The Surgical Treatment of Chronic Pulmonary Abscess by Lobectomy," *New International Clinics*, 1:184, 1941.
10 Franklin, R. M.: "Bronchographic Study of Apparently Healed Abscesses," *Am. J. Med. Sciences*, 198:95, 1939.
11 Neuhoff, H.: "Acute Putrid Abscess of the Lung," *Surg., Gynec. and Obst.*, 80:351, 1945.

A Comparative Study of the Susceptibility of Acid Fast Bacilli to Streptomycin, PAS, Neomycin and 4-Acetylaminobenzaldehyde Thiosemicarbazone*

ARTHUR H. K. DJANG, M.D.,† EMIL BOGEN, M.D., F.C.C.P.
and DRAKE W. WILL, B.S.
Olive View, California

Introduction

Robert Koch[1] in 1882 discovered the bacillus of human tuberculosis, Maffucci[2] in 1886 distinguished the avian form and Theobald Smith[3] soon after differentiated the bovine type. At present, more than a dozen kinds of tubercle bacilli and many more other forms of acid fast bacilli have been described.

Because of the emergence of strains resistant to antibiotics and other agents and the apparent infection of human beings by these and other strains of tubercle bacilli, it has become necessary to determine the susceptibility of the different types of acid fast bacilli to chemotherapeutic agents.

Experimental Procedure and Findings

Streptomycin, sodium PAS, neomycin and 4-acetylaminobenzaldehyde thiosemicarbazone were added to Dubos' Tween albumin media separately, and serial dilutions were made in vials. The final volume in each vial was 5 cc. of Dubos' media. An inoculum of 0.05 cc. of a 2 weeks old culture of different strains of acid fast bacilli grown in Tween albumin medium was added to each dilution. E. coli and staphylococcus aureus were also used as controls.

Turbidimetric measurements showing the amount of growth in the culture were made on the day after inoculation, and weekly up to eight weeks. Readings on E. coli and staphylococcus aureus were also made at 12, 24, 36, and 72-hour intervals after inoculation.

Five types were identified among the 37 strains of acid fast bacilli, as follows:

*This study was supported in part, by grants from the U. S. Public Health Service, the Los Angeles County Tuberculosis and Health Association and the California Tuberculosis and Health Association.

From Department of Infectious Diseases, School of Medicine, University of California at Los Angeles and Western Trudeau Streptomycin Laboratory, Olive View, California.

†Barlow Sanatorium, Los Angeles, California.

1) *Mycobacterium tuberculosis hominis:*

Virulent

2808—H37 Rv originally obtained from Dr. W. Steenken, Jr., Trudeau Sanatorium.
5—B88 originally obtained from Dr. C. R. Smith, Barlow Sanatorium, Los Angeles, California.
3448—H98 originally obtained at autopsy at Olive View.
3449—Obtained from Dr. H. Corper, Denver, Colorado.
113—Isolated from Patient H at Olive View.
986—Isolated from Patient T at Olive View.
3424—Streptomycin resistant strain isolated from Patient D at Olive View.

Avirulent

2807—H37 Ra.
3431—R1 Ra.
3432—R1 Rv.
3436—JHB6.
3435—H4 Ra.
3437—JHB16.
The six strains listed above were obtained from Dr. W. Steenken, Jr., Trudeau Sanatorium.
595—Streptomycin dependent strain isolated from Patient H at Olive View.[4]

2) *Mycobacterium tuberculosis bovis:*

Virulent

2806—Ravenel strain obtained from Dr. M. G. Ball, U.C.L.A.
3450—Obtained from Dr. H. Corper, Denver, Colorado.

BCG

9—Olive View strain.
3429—Obtained from Dr. J. Aronson, Henry Phipps Institution, Philadelphia, Pennsylvania.
3441—Obtained from Dr. Suhrland, New York, New York.

3) *Mycobacterium avium.*

3459—Obtained from Dr. A. Karlson, Mayo Foundation.
7—An avian strain originally isolated from a partridge at Olive View.

4) *Mycobacterium ranae:*

3439—Streptomycin susceptible strain.
3440—Streptomycin dependent strain.
Both obtained from Dr. D. Yegian, Ray Brook State Tuberculosis Hospital.

5) *Saprophytic Acid Fast Bacilli:*

Mycobacterium smegmatis—3443 (A.T.C.C. No. 361).

Mycobacterium Phlei

3430—Obtained from Dr. W. Steenken, Jr., Trudeau Sanatorium.
3453—Obtained from Dr. C. M. Carpenter, School of Medicine, U.C.L.A.

TABLE I

INHIBITION OF ACID FAST BACILLI IN TWEEN ALBUMIN MEDIA

STRAIN Agent Concentration mcgms. Per/cc.	Human Virulent							Human Avirulent							Bovine Virulent		B. C. G.			Avian		Amphibian	
	2803	5	3448	3449	113	986	3424	2807	3431	3432	3436	3424	3437	595	2806	3450	9	3429	3441	3430	7	3439	3440
Streptomycin:																							
1	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	3
10	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3
100	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1
Na PAS:																							
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	3	3	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	3	2	2	3	3	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2	3	2	2	3	1	0
Neomycin:																							
1	2	2	1	0	2	2	2	1	0	1	0	0	0	0	1	1	2	1	0	2	2	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Acetylamino-Benzaldehyde Thiosemicarbazone:																							
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	3	3	3	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	3	3	3	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	3	3	0
Control	3	3	3	3	-	3	3	3	2	2	2	2	3	0	3	3	3	3	3	3	3	3	0

TABLE I (Continued) INHIBITION OF ACID FAST BACILLI IN TWEEN ALBUMIN MEDIA

STRAIN Agent Concentration mcgms. Per/cc.	SAPROPHYTIC ACID FAST 3443	3430	3453	3438	3454	3455	2161	3428	3451	3452	3444	3445	3446	3447	*E. Coli	*Staph. Aur.	Uninoculated Controls
Streptomycin:																	
1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0
10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Na PAS:																	
1	3	3	3	3	2	2	3	2	3	2	3	3	3	3	3	3	0
10	3	3	3	3	2	2	3	2	3	2	3	3	3	3	3	3	0
100	3	3	3	3	2	2	3	2	3	2	3	3	3	3	3	3	0
Neomycin:																	
1	2	0	0	2	1	2	3	3	2	2	0	3	1	0	1	3	0
10	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0
100	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
4-Acetylamino-Benzaldehyde Thiosemicarbazone:																	
1	3	3	3	3	3	3	3	2	3	1	3	3	3	3	3	3	0
10	3	3	3	3	3	3	3	1	3	1	3	3	3	3	3	3	0
100	3	3	3	3	3	3	3	1	3	1	3	3	3	3	3	3	0
Control	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0

0 No growth. 1 Slight growth. 2 Moderate growth. 3 Heavy growth.
Results recorded in the table are one month's reading of repeated experiments.
* Indicates the results of 24 hour readings.

Chromogen strains
3438—Isolated from patient at Olive View.
3454—Isolated from patient at Olive View.
3455—Isolated from patient at Olive View.

Mycobacterium leprae?
3451—A.T.C.C. Myco. leprae No. 66.
3452—Obtained from Children's Hospital, Los Angeles.

Others
2161—Isolated from Patient T. at Olive View.
3428—Obtained from Dr. C. R. Smith, Barlow Sanatorium, Los Angeles.
3444—A.T.C.C. Myco. sp. No. 607.
3445—A.T.C.C. Myco. sp. No. 8157.
3446—A.T.C.C. Myco. avium No. 4676.
3447—A.T.C.C. Myco. sp. No. 599.

The results of the observations are summarized in Table I.

Ten micrograms of streptomycin per cc. of media inhibited all bacteria tested, except streptomycin resistant and dependent strains and Mycobacterium leprae 3452. PAS, 10 micrograms per cc. of media, inhibited all human type tubercle bacilli including streptomycin resistant strain, but not bovine, avian, amphibian, and other saprophytic acid fast bacilli. Neomycin, 10 micrograms per cc. of media, suppressed the growth of most strains, but two strains of the avian tubercle bacilli used for this experiment were partially resistant toward neomycin at this concentration. 4-Acetylaminobenzaldehyde thiosemicarbazone, 10 micrograms per cc. of media, inhibited all human strains and virulent bovine strains but no other acid fast bacilli.

The results in Table I suggest the possibility that streptomycin, PAS, neomycin and 4-Acetylaminobenzaldehyde thiosemicarbazone in 10/cc. concentration might be used as a screening spectrum for the identification of acid fast bacilli. The results seemed to indicate a characteristic reaction pattern among the acid fast bacilli toward these four agents.

Discussion

Streptomycin sensitive, resistant and dependent strains of human type tubercle bacilli could not be distinguished on gross inspection or even when observed by phase or electron microscope.[5]

However, this study indicated that distinctive physiological behaviours could be observed in different strains of tubercle bacilli and other acid fast organisms.

Differentiation of tubercle bacilli by their reaction pattern toward chemotherapeutic agents may have a two-fold significance in practical application.

1) Therapeutically, it may help in the selection of effective agents.

2) Preventively, it may clarify the epidemiological picture and indicate the source of infection.

Past classifications or identifications of types of acid fast bacilli have not been entirely satisfactory.[6-13] Even in animal inoculation, there are sources of errors.[14-16]

The activity of streptomycin against tuberculosis organisms in vitro was demonstrated[17] soon after the announcement of the isolation of the antibiotic.[18] Its effect on other acid fast bacilli was also reported.[19]

PAS[20-22] was uniformly reported to have an inhibitive effect on the virulent human type of tubercle bacilli. Its action toward other acid fast bacilli, however, showed rather conflicting results according to the reports appearing in the literature, especially regarding the bovine type of tubercle bacilli. Domagk[23] reported that PAS was totally ineffective in controlling experimental tuberculosis caused by the bovine strain in guinea pigs. On the other hand, Youmans[22] stated that one of the bovine strain was inhibited by PAS in vitro.

In our experiments, not only virulent bovine tubercle bacilli, but also the non-virulent form, BCG, were resistant to PAS.

Neomycin[24,25] was shown to be active by Waksman and Lechevalier against human and avian types, including Myco. ranae, Myco. phlei, Mycobacterium 607, and streptomycin resistant strains of tubercle bacilli. Our observations here also showed that neomycin is effective against all types of mammalian as well as non-mammalian and saprophytic acid fast bacilli.[26]

4-Acetylaminobenzaldehyde thiosemicarbazone was reported by Domagk[23,27] to be effective in controlling infections produced by virulent human and bovine tubercle bacilli. In our experiment, 4-Acetylaminobenzaldehyde thiosemicarbazone was inhibitory to virulent bovine strains but not to the non-virulent BCG strains or to other saprophytic acid fast bacilli.

The avirulent Mycobacterium No. 607[28-30] has been widely used for studies of acid fast bacilli. However, as the table shows, this organism does not behave as a human type tubercle bacillus and so is not suitable for the purpose of evaluating or testing a chemotherapeutic agent for tuberculosis.

SUMMARY

Thirty-seven different strains of acid fast bacilli, E. coli and staph. aureus were used as test organisms against streptomycin, PAS, neomycin and 4-Acetylaminobenzaldehyde thiosemicarbazone.

Human type tubercle bacilli were inhibited by all of the above agents, virulent bovine bacilli by all but PAS, avian bacilli were resistant to all but streptomycin, while BCG and the saprophytic

strains were susceptible to streptomycin and neomycin but unaffected by PAS or 4-Acetylaminobenzaldehyde thiosemicarbazone.

These characteristic reaction patterns are useful in the identification and classification of strains of acid fast bacilli.

RESUMEN

Treinta y siete diferentes cepas de bacilos acido-resistentes, E. coli, y Estafilococo áureo se usaron como organismos de prueba contra la estreptomicina, neomicina y la 4-acetilamino-benzaldehido tiosemicarbazona.

El bacilo tuberculoso tipo humano fué inhibido por todos los agentes arriba mencionados; el bacilo bovino virulento lo fué por todos menos el PAS; el bacilo aviario fué resistente a todos menos a la estreptomicina, en tanto que BCG y las cepas saprofitas fueron susceptibles a la estreptomicina y a la neomicina pero fueron afectados por el PAS o la 4-acetilaminobenzaldehido tiosemicarbazona.

Estos cuadro característicos de reacción son útiles en la identificación y clasificación de las cepas de bacilos acido-resistentes.

RESUME

Trente sept souches différentes de bacilles acido-résistants, de colibacilles, et de staphylocoques dorés ont été utilisées comme germes témoins contre la streptomycine, le PAS, la néomycine et l'amithiazone.

Chaque type de bacille utilisé s'est comporté d'une façon caractéristique à l'égard des quatre agents chimiothérapiques.

La recherche courante de la sensibilité des germes isolés des malades à l'égard des quatre produits a donné des résultats très nets tant au point de vue thérapeutique qu'au point de vue épidémiologique.

Le mycobactérium 607 n'est pas un bacille sur lequel on puisse compter pour évaluer ou déterminer l'action d'un produit nouveau, tuberculostatique ou tuberculicide. Dans ce but, il est préférable d'utiliser la souche humaine avirulente H37 Ra si dans les leboratoires où se font les recherches on ne veut pas manipuler des bacilles tuberculeux humains virulents.

REFERENCES

1 Koch, Robert: "Die Aetiologie der Tuberkulose," *Mitt. a. d. Kais. Gesundheitsampte.*, 19:221, 1882.
2 Maffucci, A.: "Die Hühnertuberkulose: experimentelle Untersuchungen," *Ztschr. F. Hyg. u. Infektionskrank.*, 11:445, 1891-92.
3 Smith, Theobald: "Studies in Mammalian Tubercle Bacilli. III. Description of a Bovine Bacillus from the Human Body. A Culture Test for Distinguishing the Human from the Bovine Type of Bacilli," *J. Med. Rev.*, 13:253, 1904-05.
4 Doane, E. A. and Bogen, E.: "Streptomycin Dependent Tubercle Bacilli," *Am. Rev. Tuberc.*, 64:192, 1951.

5 Will, D. W., Bishop, F., Bogen, E., Djang, A. H. K. and Carpenter, C. M.: "Morphology of Acid Fast Bacilli," *Dis. of Chest*, 19:387, 1951.
6 Kirchheim, L. and Tuczek, K.: "Experimentelle Untersuchungen über die Wirkung von Deuteroalbumose auf gesund und tuberkulose Meerschweinchen," *Arch. exp. Path. und Pharm.*, 77:387, 1914.
7 Masucci, P. and McAlpine, K. L.: "Biochemical Studies of Bacterial Derivatives; Preparation and Chemical Composition of Timothy Bacillus Polysaccharde M.B. 200," *Am. Rev. Tuberc.*, 22:682, 1930.
8 Branch, A.: "A Carbohydrate Common to the Group of Acid Fast Organisms, Including the Tubercle Bacilli," *Tubercle*, 13:481, 1932.
9 Seibert, F. B. and Morley, N.: "The Relationship of the Tuberculin Proteins of Different Acid Fast Bacilli to Sensitization," *Jour. Immunol.*, 24:149, 1933.
10 Higginbotham, M. W.: "A Study of Heteroallergic Reactivity of Tuberculin-desensitized Tuberculous Guinea Pigs, in Comparison with Tuberculous and Normal Guinea Pigs," *Am. J. Hyg.*, 26:197, 1937.
11 Seibert, F. B.: "Precipitin Tests and Differentiation of Various Tuberculin and Timothy Bacillus Proteins," *Am. Rev. Tuberc.*, 21:370, 1930.
12 Smith, T.: "A Comparative Study of Bovine Tubercle Bacilli and of Human Bacilli from Sputum," *J. Exp. Med.*, 3:451, 1898.
13 Jensen, K. A.: "Les types humain et bovin du bacille tuberculeux. Bacilles tuberculeux et paratuberculeux," Masson et Cie, pp. 83-97, 1950.
14 Jaffe, R.: "Anatomie und pathologie der Spontanerkrankungen der kleinen Laboratoriumstiere," Julius Springer, Berlin, 1931.
15 Seifried, O.: "Die wichtigsten Krankheiten des Kaninchens," *Ergeb. d. allg. Path. u. path. Anat.*, 221:500, 1927.
16 Branch, A.: "Spontaneous Infection of Guinea Pigs," *J. Inf. Dis.*, 40: 533, 1927.
17 Schatz, A. and Waksman, S. A.: "Effect of Streptomycin and Other Antibiotic Substances Upon Mycobacterium Tuberculosis and Related Organisms," *Proc. Soc. Exp. Biol. and Med.*, 57:244, 1944.
18 Schatz, A., Bugie, E. and Waksman, S. A.: "Streptomycin, a Substance Exhibiting Antibiotic Activity Against Gram Positive and Gram Negative Bacteria," *Proc. Soc. Exp. Biol. and Med.*, 55:66, 1944.
19 Youmans, G. P. and Fischer, M. W.: "Action of Streptomycin on Microorganisms in Vitro," *Streptomycin*, Williams and Wilkins Co., 1949, pp. 91-111.
20 Lehmann, J.: "Chemotherapy of Tuberculosis," *Svenska Lakartidnigen.*, 43:2029, 1946.
21 Sievers, O.: "Experimental Trials with PAS Against Various Kinds of Bacteria," *Svenska Lakartidningen.*, 43:2047, 1946.
22 Youmans, G. P., Raliegh, G. W. and Youmans, A. S.: "The Tuberculostatic Action of PAS," *J. Bact.*, 54:409, 1947.
23 Domagk, G.: "Investigations on the Antituberculous Activity of the Thiosemicarbazones in Vitro and in Vivo," *Am. Rev. Tuberc.*, 61:8, 1950.
24 Waksman, S. A. and Lechevalier, H. A.: "Neomycin, a New Antibiotic Active Against Streptomycin Resistant Bacteria, Including Tuberculosis Organisms," *Science*, 109:305, 1947.
25 Waksman, S. A., Hutchinson, D. and Katz, E.: "Neomycin Activity Upon Mycobacterium Tuberculosis and Other Mycobacteria," *Am. Rev. Tuberc.*, 60:78, 1949.
26 Bogen, E., Djang, A., Bowman, H. and Margulies, B.: "The Effect of Neomycin in Tuberculosis in Culture Media, in Guinea Pigs and in Patients," *Tuberculology*, 12:175, 1951.
27 Domagk, G.: "Chemotherapie der Tuberkulose mit den," *Thiosemikarbazonen*, Georg. Thiem Verlag, Stuttgart, 1950.
28 Tobie, W. C.: " 'Mycobacterium No. 607' and Similar Doubtful Tubercle Bacilli," *Am. Rev. Tuberc.*, 58:693, 1948.
29 Freedlander, B. L.: "The Chemotherapy of Benzophenone and Allied Compounds," *Am. Rev. Tuberc.*, 49:543, 1944.
30 Fitzgerald, R. S. and Feinstone, E. W.: "Nature of Activity of Sulfonilamides for the Tubercle Bacillus," *Proc. Soc. Exp. Biol. and Med.*, 52:27, 1943.

Peridural Anesthesia, an Improved Anesthesia for Thoracic Surgery from the Viewpoint of the Patient, Chest Surgeon and Physician*

C. A. BRASHER, M.D., F.C.C.P.,† Mt. Vernon, Missouri,
W. W. BUCKINGHAM, M.D., F.C.C.P.,†† Kansas City, Missouri,
O. B. CRAWFORD, M.D.,††† Springfield, Missouri,
POUL OTTOSEN, M.D., F.C.C.P.,§ Mt. Vernon, Missouri and
ALAN BAILEY, M.D., F.C.C.P.,§§ Mt. Vernon, Missouri

Peridural anesthesia has been used as the sole anesthetic agent at the Missouri State Sanatorium since October 30, 1945. It has been used in 1,018 consecutive surgical procedures. Conduction[1] anesthesia has become increasingly popular during the last decade since physicians and patients alike realize the innumerable advantages which it offers. These advantages are especially applicable to the chronically ill patient, who, as a result of his long illness, becomes a rather poor surgical and anesthetic risk. This is particularly true in diseases of the chest. It is our contention, therefore, that peridural anesthesia should be considered as a method of choice in thoracic surgery.

The peridural space is a closed potential space which exhibits a negative pressure when the spinal needle pushes forward the medullary layer of the dura mater which lies adjacent to the arachnoid. It is closed above at the foramen magnum by the fusion of the lining of the vertebral canal and the dura mater and is closed below at the sacrococcygeal junction (Figure 1).

Corning[2] first administered peridural anesthesia in animal experimentation in 1885. Among others, Fidel Pages[3] reported satisfactory anesthesia after using the peridural space by way of intraspinous approach. Thirteen years later Dogliotti[4] described the first practical technic for administering segmental peridural anesthesia through a lumbar approach. In 1944, Vasconcelos[5] reported the use of peridural anesthesia for various surgical procedures. Peridural was first brought to the Missouri State Sana-

*All surgical procedures are from the surgical service at the Missouri State Sanatorium, Mt. Vernon, Missouri. Presented at the 17th Annual Meeting of the American College of Chest Physicians, Atlantic City, New Jersey, June 10, 1951.

†Superintendent and Medical Director, Missouri State Sanatorium.
††Chief of Surgery, Missouri State Sanatorium.
†††Consultant Anesthesiologist, Missouri State Sanatorium.
§Resident Surgeon, Missouri State Sanatorium.
§§Assistant Resident Surgeon, Missouri State Sanatorium.

torium by Arnaldo Neves, M.D., Rio de Janeiro, Brazil, who had seen the procedure and had learned to do it under supervision. After using it in several operations, we decided that it is the best anesthesia available for our purposes.[6]

Figures 1 and 2 show our high peridural as distinguished from the ordinary caudal anesthesia. Technic in general is not mentioned as publications are available giving the procedure in detail.[7-10]

Among the 1,018 surgical procedures presented, the following operations were performed:

TABLE I

Pneumonectomies	97
Lobectomies	100
Thoracoplasties	635
Extrapleural pneumothorax with lucite marbles	101
Exploratory thoracotomies	18
Open pneumonolysis	24
Rib resections	8
Pericardial cystectomies	3
Secondary closures	7
Closed pneumonolysis	1
Closure broncho-pleural fistula	2
Abdominal Surgery	1
Nephrectomies	2
Nephrolithatomy	1
Schedes	3
Removal of tuberculoma	1
Decortications	13
Monaldi	1
Total Surgical Procedures	1,018

The illustrated cases had contra-lateral collapse such as thoracoplasty, extra pleural pneumothorax with lucite marbles, pneumothorax or previous resection at the time of surgery (Figure 3, 4 and 5).

We would like to draw special attention to lobectomies and pneumonectomies where peridural anesthesia was used and where there was some other method of collapse existing at the time of resection (Table II).

Of the 958 thoracic surgical procedures, 125 patients had collapse of the contra-lateral lung at the time of surgery.

Supplementary Anesthesia

Supplementary anesthesia was used in 44 out of 1,018 surgical procedures (4.2 per cent). We believe that there are two indications for supplemental anesthesia. The first indication being

psychological, that is, when the patient is psychoneurotic, or is not exactly psychologically a fit subject for peridural anesthesia. This is determined by the surgeon through various pain tests, proving to his satisfaction no actual pain exists. Of the total 4.2 per cent, 2.2 per cent were unsatisfactory on a psychological basis. Sodium pentathol is used successfully for psychological supplemental anesthesia but not effectively when the patient experiences actual pain. Second, supplemental anesthesia was used for the alleviation of pain. This group comprised 2 per cent of the total. In these latter cases, it is necessary to use nitrous oxide. This is not considered as supplemental anesthesia if used less than 30 minutes. Only 1 per cent of our peridurals were considered complete failures. In these cases it was necessary to use nitrous oxide for varying intervals of time extending over 30 minutes.

We would like to emphasize that of the cases reported, peridural was used on persons ranging from nine to 65 years of age with

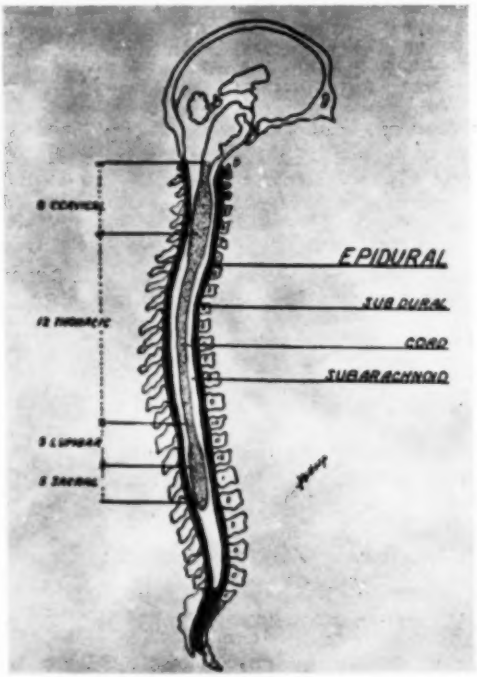


FIGURE 1: Schimatic saggital section showing contrasting Anatomy of high and low (epidural) peridural space.

one nine year old girl having a right middle and upper lobe and segment of the lower lobe removed for bronchiectasis.* The six procedures shown in Table III were on children under 16 years of age.

We would like to again emphasize that peridural was the sole anesthesia used in these cases except for the supplemental anesthesia mentioned above and (1) in no case was it necessary that an endotracheal tube be used and (2) oxygen was given inter-

*Soon after this manuscript was written a young lady age 19 has had three lobes removed for non-tuberculous bronchiectasis. This patient has been discharged and is living and well.

TABLE II

OPERATIONS PERFORMED UNDER PERIDURAL ANESTHESIA ON PATIENTS WITH CONTRA-LATERAL COLLAPSE

OPERATIONS	TYPE OF COLLAPSE OF CONTRA-LATERAL LUNG				
	Pneumothorax	Thoracoplasty	Marble Pack	Lobectomy	Total
97 Pneumonectomies	3	-	-	-	3
101 Lobectomies	10	3	3	3	19
635 Thoracoplasties	64	1	2	2	69
101 Extrapleural Marble Packs	14	8	5	-	27
24 Open Pneumonolyses	5	1	1	-	7
TOTALS	96	13	11	5	125

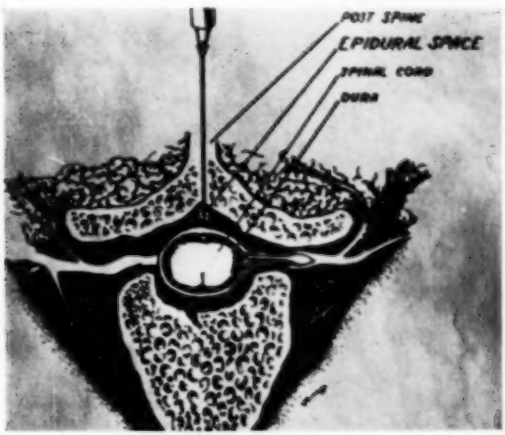


FIGURE 2: Cross section showing anatomical relation of peridural space and showing spinal needle in (epidural) peridural space.

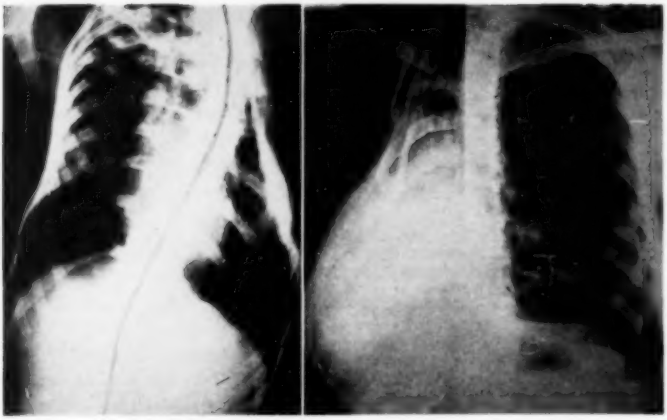


FIGURE 3 FIGURE 4

Figure 3: Peridural sole anesthetic agent for all surgery. Right extrapleural plombage performed after left thoracoplasty. Patient previously had bilateral pneumothoraces, discontinued before surgery.—*Figure 4:* Patient with left pneumothorax subsequently had right pneumonectomy and post-pneumonectomy thoracoplasty, both performed under peridural.

FIGURE 5 FIGURE 6

Figure 5: This patient, as well as one shown in Figure 3, illustrates the fact that peridural can be used in multiple operations on the same patient in spite of scoliosis and kyphosis. This patient had a left pneumothorax at the time of surgery.—*Figure 6:* Left pneumonectomy performed under peridural. Patient 12 years of age.

mittently via face mask; therefore, the patient is conscious and capable of conversing with the anesthetist and surgeon and is able to move himself from the operating table and bed, if it were necessary. We found that the above factors, according to our observations, improved the morale of the patients as compared with the morale of our surgical patients during the time all surgical procedures were executed under general anesthesia. In fact, we discovered that many patients were quite fearful of being put to sleep for surgery.

In previous reports we have used the combination of procaine or metycaine with pontocaine. In the last 359 cases xylocaine solution† has replaced procaine as the primary agent. Since using xylocaine instead of procaine, etc., the time between the first injection and the initial skin incision has been reduced from 25 minutes to eight and 10 minutes.

There occurred in the 1,018 series three deaths on the table or immediately following surgery where it was thought that peridural

†We wish to be sure that xylocaine (Astra Pharmaceutical Company) which is used in the 1 per cent solution is not confused with zylecaine (Abbott Pharmaceutical Company) which is used primarily in rectal surgery.

TABLE III

PROCEDURES ON CHILDREN UNDER SIXTEEN YEARS OF AGE

Total Children Operated — 6

Operation	Age	Diagnosis	Present Status
1. Pneumonectomy	12	Bilateral extensive tuberculous, bronchitis and bronchiectasis, left lung. *Minimal tuberc., right lung.	Arrested Discharged Living and Well
2. Lobectomy, Right, Lower and Middle	10	Bronchiectasis; Non-tuberc.	Discharged Living and Well
3. Lobectomy, Right Upper and Middle, and Segment Right Lower	9	Bronchiectasis; Non-tuberc.	Discharged Living and Well
4. Lobectomy, Left Lower	15	Bronchiectasis; Non-tuberc.	Discharged Living and Well
5. Lobectomy and Lingulectomy and Left Lower	12	Bronchiectasis; Non-tuberc.	Discharged Living and Well
6. Lobectomy, Right Lower and Middle	10	Bronchiectasis, Non-tuberc.	Discharged Living and Well

*Definite infiltration present.

might be a factor. Necropsy was performed immediately after death and the pathologist made a special examination of the spinal fluid for evidence of local anesthetic agent. The final diagnosis was coronary thrombosis on one and cardiac failure on the other.§ The third death was a cardiac arrest, preceded by intercostal paralysis. In this case the chief or consultant anesthesiologist was not present and if he had been, we believe that this would have been avoidable. No lives need be lost if an adequate resuscitation team has been organized and if each member, i.e., surgeons and anesthesists has a definite assignment and carries it out at the time of the emergency.

Frequent changes in the concentration of xylocaine have been necessary in order to find the optimal solution which will result in sensory anesthesia with little or no motor nerve involvement. We have found this concentration to be 0.8 per cent. As our volume of anesthetic solution is fairly standard at 30 cc., we use 12 cc. of 2 per cent xylocaine† diluted with saline to said volume. (Total of 240 mgms.).

If prolonged surgery is anticipated, pontocaine hydrochloride is added in concentration of 0.05 to 0.15 per cent in correlation with the expected duration.* The manufacturer of xylocaine combines epinephrine hydrochloride with their product and thus eliminates our adding it to the solution.

Advantages of Peridural Anesthesia

1. Patient awakes with cough reflex preserved and has continual evacuation of bronchopulmonary secretions.
   (A) Results in low incidence of spreads (one of the chief objectives in thoracic surgery):
      (1) Total Cases (1,018)—Spreads: 1.4 per cent
      (2) Total Resections (202)—Spreads: 0.3 per cent
2. The general well-being of these patients post-operatively is most appealing to the patient, surgeon and nurse as in contrast to general anesthesia.
   (A) Patients have less gastro-intestinal symptoms such as nausea and vomiting and less distention and paralytic ileus and can more readily evacuate the gastric intestinal tract.
   (B) Patients have less neurological symptoms, such as headaches after the usual subarachnoid spinal anesthesia.

---

§It is our belief, however, in the second death that massive subdural injection was a major factor with possible inadequate handling of the emergency.

*All patients are skin-tested for sensitivity to the anesthetic agents prior to surgery.

(C) Catherization definitely less frequent with peridural anesthesia when compared with other types of anesthesia.
(D) Blood loss at surgery is immediately replaced by transfusions started pre-operatively.

3. There is less shock noted, correlated with less loss of blood and capillary oozing. Blood loss measured roughly by sponge count:
   (A) Resections,
      (1) Before peridural when N_2O used prepared 30 tapes per operation and used 25 plus.
      (2) With peridural prepare 25 tapes and use on an average 15 per operation.
   (B) Thoracoplasties,
      (1) Before peridural with N_2O: first stage prepared 50 tapes per operation and 35 to 40 used; second and third stages with N_2O prepared 50 tapes and used 25 to 30 per operation.
      (2) With peridural: first stage prepared 30 tapes and used 20 to 25 per operation; with second and third stages with peridural, prepare 30 tapes and used 15 to 20.
4. Cautery can be used safely throughout surgery.
5. There is no great impairment of oxygenation of patient and there is a minimal deviation from normal physiology particularly during surgery and post-operatively.
6. Relatively non-toxic anesthetic and an agent which primarily effects sensory nerves. Present agent xylocaine (Astra) not be confused with zylecaine (Abbotts). Should not be used in stronger solution than 1.1 per cent as a stronger solution often causes intercostal paralysis effecting motor nerves. Further work has been done regarding the optimum dosage since this paper was submitted. It is felt that the ideal dosage in thoracoplasties and other non-resection surgery is xylocaine 0.8 per cent. In pneumonectomies and lobectomies a 0.7 per cent solution of xylocaine is used. Pontocaine in solution of 0.07 per cent to 0.1 per cent is added for prolongation of anesthesia. It is thought that the ideal dosage of pontocaine solution to be used is 0.07 per cent.
7. Particularly adaptable to tuberculous patients and other chest cases with low vital capacity and who also have lowered resistance associated with chronic illness and associated pathological changes, as well as physiological changes.
8. Can be used in mental patients occasionally transferred from hospitals for the mentally ill.
9. Good peridural entirely eliminates pain. Considerable pain often experienced by patient where local used.

10. One puncture only is required in peridural while locals require numberous punctures.
11. Local anesthesia is more time consuming than peridural.
12. Peridural can be used in surgery where there is coincidental infection such as empyema, draining sinus, et cetera.
13. Peridural has low incidence of wound infection.

Disadvantages

1. It is often stated that the conscious patient prevents liberal discussion of the surgical problems at hand. The consciousness of the patient has not interrupted routine in any manner.
2. Not suitable for extremely psychoneurotic patients.
3. Coughing paroxysms occur occasionally with ligation of a bronchus.*
4. Anesthesiologist should be well acquainted with physiology, anatomy concerning peridural space and with the technic of administration. When he starts doing peridurals, he should work with and under the supervision of another anesthestist well-versed in the procedure.

Conclusions

1) Peridural anesthesia is particularly adaptable to tuberculous patients and other thoracic surgical patients who are debilitated due to pathological, physiological, and chemical changes such as low cardio-respiratory reserve which changes are associated with their chronic illness.

2) We believe this technique is worthy of consideration both by surgeons and anesthesiologists because of the many advantages peridural offers.

SUMMARY

1) Peridural anesthesia has been used as the sole anesthetic agent in 1,018 consecutive major thoracic surgical procedures.

2) In 125 of the cases the contra-lateral lung was carrying some type of collapse therapy at the time of the second surgical procedure.

3) The ages of the patients operated ranged from nine to 65.

4) There were six children in this series, ages ranging from nine to 15. The surgical procedures were all resections.

5) Two deaths occurred which were thought to be associated with the anesthetic.

*This has been overcome since paper presented by vagus nerve block prior to manipulation of bronchus. This, of course, does not affect the cough reflex or evacuation of sputum as regards the contralateral lung. It has been upon rare occasions that it has been necessary to use this procedure.

6) One per cent of the anesthetics were complete failures.

7) Four and two-tenths per cent of the anesthetics needed supplementary anesthesia.

8) The total incidence of spread was 1.4 per cent.

RESUMEN

1) La anestesia peridural ha sido empleada como el único agente anestésico en 1,036 operaciones torácicas mayores.

2) En 125 casos el pulmón contra-lateral estaba sujeto a algunos tipos de terapia de colapso, cuando se realizó el segundo procedimiento quirúrgico.

3) Las edades de los pacientes operados oscilaban de 9 a 65 años.

4) Hubo seis niños en esta serie, cuyas edades oscilaban entre 9 y 15 años. Todos los procedimientos quirúrgicos consistieron en resecciones.

5) Ocurrieron dos muertes, que se pensó tenían relación con el uso del anestésico.

6) Uno por ciento de las anestesias fracasaron completamente.

7) Cuatro y dos décimos por ciento de las anestesias, requirieron anestesia suplementaria.

8) La incidencia total de diseminación fué de 1.4 por ciento.

RESUME

1) L'anesthésie péridurale a été utilisée seule au cours de 1,036 interventions relevant de la grande chirurgie thoracique.

2) Dans 125 de ces cas, le poumon opposé était l'objet d'une collapsothérapie quelconque alors que l'on intervenait sur l'un des côté.

3) L'âge des malades varie entre 9 et 65 ans.

4) Parmi ces malades, il y eut six enfants dont l'âge variait de 9 à 15 ans. Toutes les interventions furent des exérèses.

5) On eut à déplorer deux cas mortels pour lesquels on considéra que l'anesthésie était en cause.

6) 1% des anesthésies échouèrent complètement.

7) Dans 4.2% des cas, on dutfaire appel à une anesthésie supplémentaire.

8) Les ensemencements post-opératoires s'élevèrent à 1.4%.

REFERENCES

1 Crawford, O. B., Ottosen, Poul, Buckingham, W. W. and Brasher, Charles, A: "Peridural Anesthesia in Thoracic Surgery: A Review of 677 Cases," *Anesthesiology*, 12:73, 1951.
2 Corning, J. L.: "Spinal Anesthesia and Local Medication of Cord," *New York State Jour. Med.*, 40:483, 1885.
3 Pages, Fidel: "Metameric Anesthesia," *Rev. san. mil. Lima*, 2:351, 1921.
4 Dogliotti, A. M.: "Un Nuovo Metodo di Anesthesia Tronculare," *Arch. de atti. d. Soc. ital. di. Chir.*, 38:797, 1932.
5 Vasconcelos, E.: "Cancer of Esophagus," *Dis. of Chest*, 10:471, 1944.

6 Fujikawa, Y. F., Neves, A., Brasher, C. A. and Buckingham, W. W.: "Epidural Anesthesia in Thoracic Surgery," *J. Thoracic Surg.*, 17:123, 1948.
7 Buckingham, W. W., Beatty, Arch. J., Brasher, Charles A. and Ottosen, Poul: "The Technique of Administering Epidural Anesthesia in Thoracic Surgery," *Dis. of Chest*, 17:561, 1950.
8 Buckingham, W. W., Beatty, Arch. J., Brasher, Charles A. and Ottosen, Poul: "An Analysis of 607 Surgical Procedures Done Under Epidural Anesthesia," *Jour. Missouri State Med. Asso.*, ¿?:485, 1950.
9 Beatty, Arch. J., Buckingham, William M. and Ottosen, Poul: "Epidural Analgesia: Its Value in General Surgery," *Surg. Clin. of North America*, 30:¿?¿, 1950.
10 Buckingham, W. W., Beatty, Arch. J., Brasher, Charles A. and Ottosen, Poul: "An Evaluation of Extrapleural Pneumonolysis with Lucite Plombage," *Am. Jour. of Surgery*, 81:401, 1951.

Discussion

PHILIP A. LIEF, M.D., F.C.C.P.
New York, New York

This comparative new type of anesthetic management for thoracic surgery must await more cases and time for proper evaluation. I should like to ask the authors how many patients were awake while hilar traction and dissection were being carried out? What was the incidence of coughing during this procedure?

Permit me to describe the rationale for our anesthetic management at the Montefiore Hospital, New York, of the patient undergoing transpleural surgery.

Preanesthetic Preparation: All children, and recently all adults, are brought to the operating room under barbiturate basal hypnosis. Atropine sulfate is given preoperatively to diminish secretions in the tracheo-bronchial tree, to obtain vagal, laryngeal, and traction reflexes during surgery. Topical anesthesia of the larynx and tracheo-bronchial tree is followed by direct laryngoscopy or bronchoscopy and orotracheal intubation. The use of an endotracheal tube aids in maintainence of a constant patent airway, tracheo-bronchial toilet, permits intermittent positive pressure breathing during transpleural surgery, and aids in stabilizing the mediastinum. From the point of view of the anesthesiologist, the greatest dangers to the patient during transpleural surgery are hypoxia and ventilatory insufficiency. Recently Beecher has reemphasized the problem of respiratory acidosis during thoracic surgery. We are of the opinion that all transpleural surgery should be undertaken only in the presence of an endotracheal tube.

Anesthesia is induced by one of the ultra-short acting barbiturates followed by nitrous oxide, ethylene, or cyclopropane in combination with oxygen. The use of intermittent intravenous morphine or demerol injections may be necessary to provide ade-

quate analgesia. Recently at the Montefiore Hospital, during prolonged transpleural surgery, we have maintained patients under seconal basal hypnosis and nitrous oxide-oxygen anesthesia by means of a mechanical respirator recently adapted for intermittent positive pressure breathing. Reinforcement with diethyl ether, divinyl ether, local procaine infiltration or curare may be necessary to abolish autonomic ganglionic reflexes.

In this manner we have a minute to minute control of the depth of anesthesia. Such is not the case with peridural analgesia. General anesthesia maintains the homeostatic compensatory mechanisms of the body much better than does spinal or peridural anesthesia. Normal blood pressures can be maintained easily, throughout prolonged surgical procedures, in spite of sudden unexpected hemorrhage of great magnitude.

For postoperative analgesia we find that dolamin (an ammonium salt) is of great aid if it is injected in the immediate area surrounding the intercostal nerves, under direct vision by the surgeon, before the thoracic cage is closed. All of our patients are wide awake and coughing in the operating room immediately following surgery. The establishment of recovery rooms in the operating suite has, in our opinion, reduced markedly the morbidity as well as mortality of patients undergoing thoracic surgery.

Closing Remarks, Charles A. Brasher, M.D., F.C.C.P., Mt. Vernon, Missouri: All patients are awake during hilar traction and dissection, and the incidence of coughing is very low.

Rare supplemental anaesthesia used was late in the operation. We don't have hypoxia and ventilatory insufficiency with peridural anaesthesia, because the anaesthetic agent, already being present in the peridural space, leaves the airway free to administer pure oxygen and positive pressures with pure oxygen at any and all times, if necessary.

It is our feeling that endotrachial tubes should not be used routinely, but only when there are sufficient indications, particularly because of discomfort to the patient. They can be inserted readily when needed.

The Rise and Fall of Physical Examination in the Diagnosis of Diseases of the Chest

A. E. T. ROGERS, M.D., F.C.C.P. and EMIL BOGEN, M.D., F.C.C.P.
Olive View, California

The history of symptoms was the basis of Hippocratic medicine, and constituted the foundation for most systems of diagnosis in ancient times. The facies and the conformation of the entire body in the various "diatheses" were also carefully described. Araeteus made especially vivid observations on the general appearance, posture and other signs of a number of diseases, especially phthisis, tetanus, diphtheria, and diabetes. More than a dozen general physical alterations were known to the ancient Greek physicians in the patients suffering with phthisis, including flushed face, dilated pupils, weak pulse, rapid respiration, diurnal fever, malaise, wasting, clubbed fingers with curved nails, winged scapulae, thin neck, and premortem edema of extremities.

Specific signs indicating localized lesions were not so readily recognized. The classic signs of inflammation were only seen in external diseases. Signs and symptoms such as dry cough, heavy, odoriferous yellow sputum, blood spitting, pain in the chest, hoarseness and diarrhoea were early associated with the disease but not so readily with its site. Perhaps the earliest of the localizing signs in the chest was the succussion splash mentioned by Hippocrates. Very few such physical signs are mentioned in the early literature, and though inspection, palpation and mensuration were probably employed, they do not appear to have been systematized.

The introduction of percussion by Auenbrugger in 1761 was followed by the discovery of a dozen different specific signs by that tragic pioneer but failed to excite much interest or following until more than half a century later. With the development of auscultation by Laennec in 1823, however, physical diagnosis began to flourish. By the middle of the century, with Flint and Skoda, this became the dominant characteristic of phthisiology. Physical diagnosis, which in the hands of some esoteric workers became a complex mystery requiring a long apprenticeship and the development of a tactus eruditus, unapproachable by the novice, gradually became the chief pride of the leading clinicians, and the very era of therapeutic nihilism coincided with the peak of diagnostic faith. The diagnostic acumen of Austin Flint, of Theodore Janeway, of William Osler in this country, of Clifford Allbutt in England, of Emile Sergent and Dumarest in France, of Skoda and Muller in

Germany, was attributed to the mastery of this exacting technique, and emulated by aspiring disciples.

Some diagnostic aids were named according to the means of eliciting them, or the diseases indicated, but more than 500 physical signs are listed in the medical dictionary under the names of their discoverers. Refinements of physical diagnosis probably reached their peak about the time of the discovery of the tubercle bacillus. Since that time, many more signs have been reported, but their discovery has become more and more rare and tentative, and since Dr. Pottenger described his pulmonary reflexes nearly half a century ago, only a few new localizing signs have been introduced in physical diagnosis.

Physical diagnosis, with its extensive repertoire of signs and procedures for eliciting them, has lost its dominant position in modern medical education and practice. This is especially notable in connection with diseases of the heart and lungs, formerly the chief bulwark of the physical diagnostician. Gone is the day of the profound specialist whose trained fingers note the differences between scores of different qualities of the pulse, whose sensitive ears distinguish between the various orders of bronchi by the pitch of the rale, and whose trained proprioceptive sense recognizes reflex muscle spasm in incipient disease not otherwise detectable. The decline in importance of physical diagnosis may be attributed to several causes. Controlled studies have shown the unreliability of signs, as compared with symptoms, laboratory findings, the later course of the disease, and autopsy findings.

Analysis of the correlation between physical findings and actual autopsy findings, so painstakingly developed by Laennec and Louis, were less thoroughly repeated by their later followers, especially in the case of the more unusual conditions and those which are less apt to be encountered in the death house. It was through the return to such careful comparisons, however, that the art of physical diagnosis received its strongest blow. The shockingly low confirmation of premortem diagnoses in cardiac conditions in the autopsies at the Massachusetts General Hospital, a center of diagnostic culture, came as a surprise and disillusionment to the profession. Other studies, of a similar nature, comparing the findings on physical examination with those of autopsies, x-ray and laboratory methods, and with the later clinical course of the patients, confirmed Cabot's observations.

Another development which contributed to no small extent to the decline of the art of physical diagnosis may be sought in the value and emphasis placed on the exact localization and description of the lesion discovered by such measures. To the physician of the latter part of the last century, the recognition of the par-

ticular valve affected, and the distinction between stenosis and insufficiency seemed most important. The rising science of bacteriology, however, led more and more to emphasis upon the exact etiological agent concerned rather than upon the exact pathological configuration temporarily assumed. Clinical cardiologists also tended to follow Mackenzie's emphasis upon function rather than form, upon compensation or decompensation, myocardial capacity, and cardio-respiratory reserve, rather than upon the anatomic localization of the site of the gross defect present.

In the case of the lungs, the same changes occurred. Instead of the distinction between lobar and lobular pneumonia, the species and type of the responsible organisms became the center of attention. The numerous classifications of bronchitis and bronchiectasis based on clinical signs were replaced by interest in the various etiological agents concerned. Lung abscesses became characterized by cause rather than by signs, and the tuberculosis worker became more interested in the type of bacillus, its rate of excretion, and its systemic effects, than in the exact description of the resulting rales and the interpretation of their pathological significance.

Most important of the factors leading to the dethronement of physical diagnosis, however, has been the rapid development of laboratory and instrumental methods in clinical medicine with their greater sensitivity, precision, objectivity and reliability. Direct instrumental observation has gone far to replace the older indirect physical diagnostic measures. The laryngoscope, the bronchoscope, the gastroscope, the thoracoscope, and latterly the cavernoscope have made possible direct observation of what was formerly terra incognita. Instead of inferring from the character of the cough, we now see the state of the vocal cords; instead of guessing at the cause of the wheezing, we look for the site of bronchial stenosis; instead of suspecting pleural adhesions or tension pneumothorax or cavities, we make direct observations or measurements. Potain, Garcia, Jackson, Jacobaeus, Schindler and Corylios have given us eyes where before we had to rely upon thumbs. Who, today, would be willing to go back to the fumbling of the past?

The bacteriological techniques early proved their greater efficacy in the differentiation of clinical entities over the previous symptomatic and physical distinctions as between diphtheria and croup, between typhoid and malaria, between tuberculosis and pneumonia. Blood examinations replaced clinical signs of anemia and sepsis. Urinalysis became chemical and microscopic instead of horologic. Clinical differentiation between pleural effusion and empyema bowed before the might of the microscope.

The introduction and development of the x-ray has been, how-

ever, the chief factor leading to the debasement of physical diagnostic acumen. Why learn arduous and untrustworthy methods of detecting suspicious signs of a pulmonary condition when a single glance at a good x-ray film will reveal the condition without question? Why founder in a morass of possibilities and probabilities from fallible signs and signals, when the actual condition may be laid bare to our eyes? In the earlier years, when the x-ray was still under-developed and the technical skill in its interpretation wanting, adherents of the old school still maintained that it was naturally inferior in sensitivity and reliability to the tactus eruditus, but the old guard has been forced to yield under the onslaught of overwhelming proof, and the superiority of the x-ray is now universally conceded. Occasionally physical diagnosis may supplement the findings of the x-ray, rarely may it replace or refute them.

The general recognition of the fact that in many cases physical signs may be uninformative or misleading has led to a severe disuse atrophy of these senses. This neglect has often been fostered by the inadequate training in physical diagnosis received by most medical students and interns. The skilled use of the eyes, ears and fingers represent an art achieved only by long and conscientious practice, and in the light of the fact that better results are obtained by a quick and painless resort to the x-ray and clinical laboratory, many feel that it is not worth the effort. Thus, in the traditional sequence of history, physical examination and laboratory confirmation, the physical examination is being more and more side-tracked. With decreasing exercise of the art, the average practitioner tends to lean more and more heavily on mechanical aids.

The universal dependence upon x-ray, with relegation of physical diagnosis to an insignificant role, is perhaps best illustrated by the procedure followed in tuberculosis clinics and sanatoria. How many of us could decide such questions as the early diagnosis of sputum-negative cases, the question of bed-rest versus collapse therapy, or the gradations of exercise, on the basis of the dullness, the breath sounds or the rales which we elicit by physical examination? Still, perhaps from habit, perhaps for the sake of the smattering of information to be gained from personal contact, we go on doing our chest examinations, mistrusting the negative findings and requiring laboratory confirmation of the positive ones.

Even at the risk of belaboring the point, a few figures may illustrate the inadequacy of physical diagnosis in pulmonary tuberculosis. There is no quicker or more complete method of deflating the examiner's ego than to review such findings in the light of the x-ray viewing box. Of 28 patients in the admitting ward of Olive

View Sanatorium, cavities were diagnosed by physical examination alone in eight or 29 per cent. The x-ray film showed cavities in 19 or 68 per cent. Thus, more than half of the cavities were missed. The sizes of the cavities which gave no distinctive physical signs ranged from 1 cm. to 3 by 5½ cm., with half of them less and half of them greater than 2 cm. in diameter. Conclusions drawn from such figures as these are obviously open to the criticism that they may depend on the skill, or lack of it, of a single examiner. However, similar results were obtained in another series where patients were examined by three independent tuberculosis specialists, and are fairly representative.

That frequent and severe physical examinations of tuberculous lungs were not without danger to patients has long been recognized, as the following epigram of Martial, cited by Webb, testifies:

> "Languid I lay, and thou camest, O Symmachus, quickly to see me. Quickly thou camest, and with thee a hundred medical students. The hundred pawed me all over with hands congealed by the north wind. Ague before I had none, but now by Apollo I have it."

It should not be inferred, however, that physical examination is an obsolete and entirely useless art. Just as the overwhelming number of situations met in everyday practice can be adequately dealt with by means of the contents of the doctor's bag, so many diagnoses can be arrived at by the sole use of the examiner's senses. Even a superficial examination can reveal with reasonable certainty such conditions as gross cardiac displacement, massive pleural effusion and acute thoracic accidents without the loss of time and the expense incident to laboratory examination. In other instances, a telltale friction rub may reveal pleural inflammation before evidence of thickening or effusion may be seen on the x-ray film, rales may precede shadows cast by exudation or consolidation on the film, and murmurs may be heard while the electrocardiogram still remains blind to cardiac pathology.

Though laboratory measures may be more sensitive and precise than physical signs, they cannot be invoked unless suspicion of conditions in which they may be useful is aroused. Only too often does an unrecognized spontaneous pneumothorax, a pleural or pericardial effusion, or internal hemorrhage prove fatal because the physician failed to use a stethoscope which would have pointed to the cause of the apparent "cardiac failure." Physical examination is far from obsolete—it is still an essential resource of every physician. But only when it is recognized for its true value, to suggest the conditions which more elaborate and precise technique may establish and delineate, will it escape the opprobrium which has clung to it from overweening reliance in the past.

SUMMARY

The use of physical signs in the diagnosis of diseases of the chest developed rapidly after the discovery of the stethoscope, and reached its acme at the end of the nineteenth century. It has since tended to decline as a result of the greater emphasis on etiological and functional, rather than on purely anatomical aspects of disease and the introduction of more sensitive and reliable endoscopic, radiologic and laboratory methods. Despite the gross fallibility of physical examination, however, neglect of its teaching and application is deplored. The eye, ears, and touch remain the quickest, simplest and most readily available means of detecting pathologic alterations. Suspicion aroused by physical findings is often the necessary precursor to the application of the instrumental, radiologic and laboratory measures which are required to establish the diagnosis. Omission of the more delicate and precise objective methods through excessive confidence in the less trustworthy physical signs can only lead to disaster.

RESUMEN

El uso de los signos físicos en el diagnóstico de las enfermedades del torax se desarrolló rápidamente después de la invención del estetoscopio, y llegó a su punto más elevado al final del Siglo Diecinueve. Desde entonces ha tendido a descender como resultado de la mayor atención sobre los aspectos etiológicos y funcionales de la enfermedad, más que sobre el aspecto puramente anatómico, y debido a la introducción de métodos más sensitivos y dignos de crédito, como los endoscópicos, radiológicos y de laboratorio.

A pesar de las grandes fallas del examen físico, sin embargo, el descuido en su enseñanza es de deplorarse. Los ojos, los oídos y el tacto siguen siendo los medios más rápidos, sencillos y más asequibles para descubrir las alteraciones patológicas.

La sospecha provocada por los hallazgos físicos, es a menudo la precursora necesaria de la aplicación de los procedimientos instrumentales, radiológicos y de laboratorio que se requieren para basar un diagnóstico.

La omisión de los métodos objetivos más sutiles por excesiva confianza en los signos físicos infieles, solo puede conducir a desastre.

RESUME

La recherche des signas physiques pour le diagnostic des affections thoraciques s'est rapidement développée après la découverte du stéthoscope et atteignit son point culminant à la fin du 19ème siècle. Depuis, l'importance de cet examen diminua. La cause en est:d'abord la plus grande importance donnée aux éléments étio-

logiques et fonctionnels qu'aux aspects purement anatomiques de la maladie, elle tient aussi à l'apparition de méthodes plus sensibles et plus valables (endoscopie, radiologie, laboratoire). Malgré la diminution considérable de l'importance de l'examen physique, on doit néanmoins déplorer que l'on néglige son étude et son application. Les yeux, les oreilles, le toucher restent les moyens les plus rapides, les plus sensibles, et les plus valables pour découvrir les lésions anatomiques. La suspicion que l'on obtient grâce à l'examen physique précède souvent de façon nécessaire l'utilisation de mesures instrumentales, radiologiques ou de laboratoire qui permettent de fixer le diagnostic. L'oubli des méthodes les plus délicates et les plus précises par une confiance exagérée dans des recherches physiques moins valables ne peut qu'entrainer des conséquences désastreuses.

College Chapter News

NORTH CAROLINA CHAPTER

The Third Annual Meeting of the North Carolina Chapter of the American College of Chest Physicians will be held on October 23, 1952. The afternoon session at the Veterans Administration Hospital, Oteen, and the evening session at the Battery Park Hotel, Asheville.

Afternoon Program, 2:00 p. m.:

"Systemic Blastomycosis: Treatment with Stilbamidine,"
William M. Kennedy, Oteen.

"Pulmonary Blastomycosis: Treatment with Undecylenic Acid,"
Timothy Takaro and J. D. Murphy, Oteen.

"Genitourinary Tuberculosis,"
Thomas R. Huffines, Asheville.

"Tuberculous Enteritis,"
Walter R. Johnson, Asheville.

"A Review of the Newer Antibiotics in the Treatment of Pulmonary Tuberculosis,"
W. Spencer Schwartz, Oteen.

Business Session; Election of Officers.

Evening Program, 8:00 p. m.:

Address: Subject to be announced,
David H. Waterman, Knoxville, Tennessee.

X-ray Conference: Moderator, G. W. Murphy, Asheville.
Members and guests are encouraged to bring interesting or unusual chest x-ray films for interpretation and discussion at the X-ray Conference.

There will be a dinner at the Battery Park Hotel, Asheville, at 6:30 p.m. Reservations for members of the Chapter and guests can be made prior to the meeting or at the time of registration for the afternoon session by contacting Dr. Leon H. Feldman, Secretary-Treasurer, Flat Iron Building, Asheville, North Carolina.

PORTUGUESE CHAPTER

The Annual Meeting of the Portuguese Chapter of the College was held on May 31, 1952, at the Sousa Martins Sanatorium, Guarda, under the direction of the Regent, Professor Lopo de Carvalho. The following program was presented, Dr. Ladislau Patricio, President, presiding:

"Contribution of Angiopneumography for the Appreciation of the Pharmacodynamic Properties of Some Drugs,"
Prof. Lopo de Carvalho, C. Vidal, J. Benard Guedes and Lopo de Carvalho, Filho.

"Respiratory Asthma,"
Celso Horta.

"The Treatment of Tuberculosis by Isonicotinic Acid Hydrazide. Immediate Results,"
Lopo de Carvalho Cancella and Vasco de Lacerda.

"Results of the First Tests with Isonicotinic Acid Hydrazide in Some Cases of Pulmonary Tuberculosis at the Sanatorium Sousa Martins,"
Manuel Cardoso.

"The Effect of Isonicotinic Acid Hydrazide on the Curves of Glycaemia in Pulmonary Tuberculosis,"
C. Vidal and C. Guimaraes.

"Pneumothorax in Broncho-Pulmonary Tuberculosis,"
Trajano Pinheiro.

"Functional Exploitation in Pulmonary Surgery,"
Prof Esteves Pinto and C. Sousa.

"Tumors of the Thoracic Wall,"
Prof. Bello Morais.

"Cardiac Asthma,"
Celso Horta.

"Pneumoperitoneum,"
Julio de Vasconcellos.

"Surgical Treatment by Hypopressure Extra-Pleural Camera of a Case of Mediastinal Emphysema,"
Martins Queiroz.

"Thirteen Cases in which Streptokinase and Streptodornase were Used,"
Joao Lacerda.

"Coartation of the Aorta, Adult Type,"
Prof. Vaz Serra.

"Case of Pneumonectomy by Tuberculosis,"
Quintanilha.

"Urgent Pneumonectomy Indicated by Pleuroscopy,"
Prof. Bello Morais and C. Vidal.

"Loeffler's Syndrome,"
Manuel Vasconcellos.

"PAS in Endovenous Perfusion,"
Galvao Lucas.

"Some Indications of Polyethylenus in the Collapse Therapy of Pulmonary Tuberculosis,"
Ruy Lima.

"Some Considerations on Caustic Stenoses of the Esophagus. A Case of Total Obstruction of the Esophagus Treated by Conservative Methods,"
Ferreira dos Santos.

"Some Aspects of the Problem of Tuberculosis in the First Half of this Century,"
Ladislau Patricio.

A luncheon and business meeting was held after the scientific session presided over by the Governor, Dr. C. Vidal and the President, Dr. Patricio. The following officers were elected for the ensuing year:

Celso Horta, Caramulo, President
Agostinho Cardoso, Madeira-Funchal, Vice President
Lopo de Carvalho Cancella, Lisbon, Secretary-Treasurer.

ANNOUNCEMENT

Parke, Davis & Company has established a new research fellowship at Mellon Institute for long range studies emphasizing viruses and tumors.

Work already has started under the supervision of Dr. Alex M. Moore, Parke-Davis laboratory director in organic chemistry, serving as administrative fellow at the Institute.

Methods of combating viruses and tumors through chemical means will be the immediate objective.

College News Notes

Dr. Aldo A. Luisada, Program Director of Cardiology and Associate Professor, Department of Medicine, Chicago Medical School, delivered two lectures at the Academy of Medicine in Turin, Italy, on heart surgery. He was awarded Honorary Membership in the Piedmontese Academy of Cardiac Surgery.

Dr. Louis H. Clerf of Philadelphia, Pennsylvania, was elected President of the American Laryngological Association at the 73rd Annual Meeting held in Toronto, Canada, May 23-24, 1952.

Professor Jorge A. Taiana, Professor of Thoracic Surgery, Buenos Aires University Medical School, has recently been appointed Dean of the University Medical School.

Dr. Hurley L. Motley, formerly Director of the Cardio-Respiratory Laboratory, Jefferson Medical College Hospital, Philadelphia, Pennsylvania, has been appointed Professor of Medicine and Director of the Cardio-Respiratory Laboratory, University of Southern California, Los Angeles.

Dr. Edgar W. Davis, Professor of Thoracic Surgery at Georgetown University School of Medicine, Washington, D. C., addressed the Southern Chapter of the International College of Surgeons. He presented a paper on "The Surgical Treatment of Mitral Stenosis" and participated in a Symposium and Panel Discussion on Surgical Treatment of Tuberculosis.

ANNOUNCEMENTS

The Seventeenth Annual Assembly of the United States and Canadian Chapters of the International College of Surgeons was held in the Conrad Hilton Hotel, Chicago, September 2, 3, 4 and 5.

The Right Honorable Lord Thomas Horder, G.C.V.O., M.D., F.R.C.P., F.R.C.S., extra physician to Queen Elizabeth, Chairman of the Fellowship for Freedom in Medicine, and member of the Council of the British Medical Association spoke at the Convocation. His subject was "Freedom in Medicine."

The University of Minnesota in conjunction with the Minnesota Public Health Association will present a continuation course in Tuberculosis for Lay Persons particularly interested in this field. The course will be held at the Center for Continuation Study on the University of Minnesota Campus from October 27 to 29, and emphasis will be placed on the public health aspect of tuberculosis.

Obituaries

DONALD FRANCIS MacINNIS
1908-1952

Dr. Donald Francis MacInnis was born on August 13, 1908, in Sparta, Minnesota. He was graduated from the Marquette University School of Medicine in 1935. In July 1936, he became a resident physician in the Oakland County Tuberculosis Sanatorium at Pontiac, Michigan. He was appointed medical director of the Oakland County Tuberculosis Sanatorium in 1941, and held this position until illness forced him to give up his medical practice. He was married in 1937 to Miss Margaret Inez Canine.

Dr. MacInnis was a young physician who had a very promising future. His early death was a great loss to the community in which he worked, as well as to the medical profession as a whole.

Herman J. Moersch, Governor for Minnesota.

SETH LeROY COX
1882-1952

On February 26, 1952, after an illness of five days, Dr. Seth LeRoy Cox died in his seventieth year at his home in Seattle, Washington, of coronary thrombosis. By his death, the tuberculosis movement lost a skilled diagnostician, who had devoted the greater part of his professional life to public service in this field.

Following graduation from the Jefferson Medical School in Philadelphia in 1912, Dr. Cox accepted an appointment for a two-year period in a government hospital in the Philippines. Returning to the United States, he and Miss Jean S. Sears of Pittsburg, Kansas, were united in marriage in September, 1915. After this country had entered the war against Germany Dr. Cox volunteered in August, 1917, for the Medical Corps, serving at hospitals in France until discharged from the Center at Kerhuon in June, 1919, with the rank of Captain. He then became medical director of field activities for the Kansas Tuberculosis Association until 1928, after which he spent three years with the Henrietta Brown Foundation for Tuberculosis Research, also in Kansas.

In September, 1931, he moved with his family to Seattle, having accepted the position of diagnostician for the state-wide clinic service of the Washington Tuberculosis Association. In this capacity he carried on a program which embraced tuberculin testing, clinics and lectures in the elementary and secondary schools, as well as in the institutions of higher education; the extension of adult clinic service and the establishment of cooperative relations with public health officials and medical groups. The outstanding success of these endeavors won Dr. Cox recognition throughout the Northwest.

Accepting an offer from the Kansas Tuberculosis Association, he returned in 1943 as director of its clinic service, being elected executive secretary of the organization in 1947. Shortly afterward, he suffered a severe heart attack which impaired his health. He retired in the spring of 1950, coming again to Seattle, where his wife suddenly passed away a few days later. In June, 1951, he married Mrs. Louise M. Bussey, who

survives him. Others are his sons, Kenneth A., of Seattle; and William P., Berkeley, California; two sisters, Mrs. John Hyatt, Kansas City, Kansas; and Mrs. Arnold Kraus, Topeka, Kansas, and one grandson. His ashes are interred in the family plot in Topeka, Kansas.

At the time of his death Dr. Cox was a member of the American Medical Association, the National Tuberculosis Association, the American Trudeau Society and the American College of Chest Physicians.

John E. Nelson, Governor for Washington.

CARL O. SCHAEFER

Dr. Carl O. Schaefer, former Governor of the College for Wisconsin, died of coronary thrombosis on June 26, 1952. He graduated from Marquette University Medical School in 1916. Subsequently, he specialized in general surgery and thoracic surgery. He held the position of Medical Director of Sunny Rest Sanatorium, Racine, Wisconsin, for 28 years, and was an active staff member of St. Luke's Hospital and St. Mary's Hospital of the same city.

His interest and active participation in College affairs inspired others with enthusiasm and ambition to emulate him in contributing their best efforts to the cause. His cheerful disposition, optimistic outlook on life and keen sense of humor attracted the affection and admiration of his colleagues. His personal charm and generosity have made him a much sought for personality. In his professional work, he was open-minded, progressive and always up-to-date. His ability as an astute clinician was well known far beyond the confines of his institutional affiliations and his own community. With his exemplary modesty, he was always willing to share with others the knowledge and wisdom he gathered from his extensive practice. Kindness and good will were the hall-marks of his splendid character. The gap his passing away has left among us will be difficult to fill for a long time to come.

Book Reviews

The Auricular Arrhythmias. By M. Prinzmetal, E. Corday, I. C. Brill, R. W. Oblath and H. E. Kruger. Charles C. Thomas, Springfield, 1952, 387 pages, 323 figures. Price $16.50.

This extremely interesting book is both a manual and a report of the authors' studies in animal and man.

After a chapter on the normal auricle, the authors study auricular premature systoles, auricular paroxysmal tachycardia, auricular flutter and auricular fibrillation. Pharmacologic and therapeutic considerations about the auricular arrhythmias, and a technical appendix, close the book.

The authors' studies are based: (1) on experimental observations by means of high speed cinematography; and (2) on conventional and cathode-ray electrocardiography in animal and man.

Two conflicting theories have been advanced in order to explain flutter and fibrillation; that of an ectopic focus (parasystole) advocated by the Vienese School (from Rothberger to Scherf) and that of a continuous

circulating stimulus (circus movement) advocated by the British School (from Lewis to Rosenblueth).

The studies of Prinzmetal seem to confirm the former and to exclude the latter by adding a notable weight of proof to previous speculations and experimentations.

The book is beautifully illustrated and is provided with a complete bibliography and a good index.

The detailed explanation of animal and clinical studies by the authors and the sketchy description of previous contributions somewhat detract from the usefulness of this book. There is no doubt, however, that it represents a milestone on the road to complete comprehension of auricular disorders.

A. A. Luisada.

Essentials in Diseases of the Chest. By Philip Ellman. Oxford University Press, London, Toronto and New York, 1952, 383 pages, x-ray reproductions and diagrammatic illustrations. Price $6.50.

The discussions in this volume are, for the purpose of brevity, very wisely confined to the commonly encountered and major diseases of the chest. The emphasis is placed on these diseases in accordance with their importance as medical problems, as is exemplified by the prominence given to pulmonary tuberculosis and intrathoracic new growths.

Dr. Ellman very richly justifies the title by presenting in a clear and attractive manner in a few concise chapters all the present day recognized essentials in the diagnosis and care of the more common diseases of the chest.

The anatomy and physiology of the respiratory tract are described from the practical standpoint. The importance and technique of history taking is stressed. The laboratory procedures essential under different circumstances are clearly discussed. Attention is called to the importance of considering the patient as a whole and to treating him as an individual. A warning is sounded that in our progressive outlook of tuberculosis we should go "wisely and slow; they stumble that run fast."

It is pointed out that in the treatment of tuberculosis there is no substitute for the basic method of treatment by bed rest and sanatorium regimen. All other therapeutic measures must be regarded primarily as adjuncts. "The sanatorium is essentially the school of the tuberculous patient and the physician his teacher."

The frequency and the value and importance of early diagnosis and treatment of cancer of the lung is clearly presented.

This book will answer a great need now present in every day practice—a need which is the direct result of the failure of medical schools to equip medical students with an essential understanding of chest diseases and conditions. At the same time this volume supplies that bridge so necessary between the chest specialists and all other practicing physicians. It is sufficiently brief for the busy physician and is instructive and stimulating reading for physicians as a whole including those whose work is confined to diseases of the chest.

There are 383 pages with many reproductions of x-rays of chests and numerous ably executed diagrammatic illustrations.

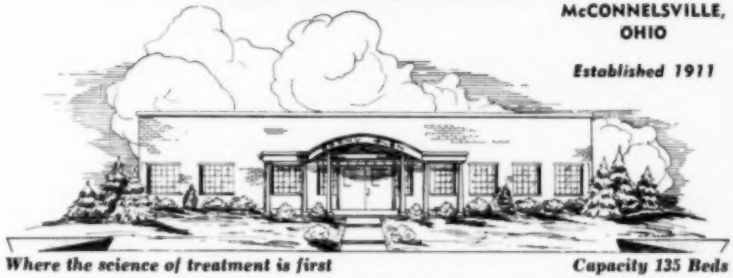
E. W. Hayes.

Rocky Glen Sanatorium

FOR TUBERCULOSIS

McCONNELSVILLE, OHIO

Established 1911



Where the science of treatment is first — *Capacity 135 Beds*

FOR THE MEDICAL AND SURGICAL TREATMENT OF TUBERCULOSIS

LOUIS MARK, M.D., Medical Director, 677 North High Street, Columbus, Ohio

HARRY MARK, Superintendent — **MRS. HARRY MARK,** Asst. Superintendent

HENRY BACHMAN, M.D., Resident Medical Director

MICHAEL L. MICHAELIS, M.D., Res. Phys. — **FELIX BACHMANN, M.D.,** Res. Phys.

L. CHANDLER ROETTIG, M.D., Surgeon — **A. N. KISHLER, D.D.S.,** Attending Dentist

Beautiful Surroundings — **Reasonable Rates**

SARANAC LAKE

THE HEALTH CENTER IN THE ADIRONDACKS FOR THE STUDY, CARE AND TREATMENT OF PULMONARY TUBERCULOSIS AND OTHER CHEST DISEASES:

Diagnosis

Complete facilities for differential diagnosis.

Accommodations

Homelike private sanatoria accommodating from 4 to 30 patients, each with private room, many with private porch and private bath. Costs: (including board and lodging) $35.00 to $80.00 per week, without nursing care; $45.00 to $95.00 per week with general nursing care.

Several semi-private sanatoria in the area accommodating 80 to 200 patients, each with private room. Maximum costs: $56.00 per week, which includes partial or full medical care.

Treatment

The most modern and time saving integration of rest, antibiotics, surgery and rehabilitation.

Research

Pioneering bacteriological, pathological, physiological and clinical research, through Trudeau Foundation facilities. Complete laboratory control, so vital in these days of new drug therapy.

Surgery

A modern General Hospital with one wing exclusively for surgery on the tuberculous. The staff includes three Diplomates of Thoracic Surgery and two Anesthesiologists.

Rehabilitation

The Saranac Lake Rehabilitation Guild provides facilities for occupational and physical therapy under licensed personnel. Instruction in 60 vocational, technical and academic subjects by 30 certified teachers and counselors. Physical therapy department includes techniques to bring relief to patients with breathing difficulties.

For complete information please write to —

Norman R. Sturgis, Executive Director,
Saranac Lake Medical Facilities, Inc.*
91 Main Street, Saranac Lake, New York

**A non-profit organization of Saranac Lake citizens interested in publicizing the many health services of the area.*

Here is what the clinicians

are reporting about NEO-PENIL*...

the new derivative of penicillin

...about its ability to concentrate in the lung:

"... concentrations of this drug in the lungs after intramuscular injection are five to ten times higher than that of benzylpenicillin [penicillin G]."[1]

...about its ability to concentrate in sputum:

"Neo-Penil gave rise to significantly higher concentrations of penicillin in bronchial secretions than did procaine penicillin ..."[2]

"Procaine penicillin, in the same dosage, produces considerably lower sputum levels or fails to appear at all."[2]

...about its effectiveness in bronchopulmonary disease†:

"Our own evidence would indicate that it is a more effective form of penicillin in patients with chronic pulmonary emphysema and bronchopulmonary infection."[4]

"This compound appeared to have a unique value in respiratory infections due to gram-positive bacteria."[1]

"Prompt reduction or elimination of pus from the sputum occurred in 75 per cent of fifty patients with chronic bronchitis and bronchiectasis, with a comparable clinical improvement."[1]

†For additional evidence, turn to page 8.

. . . about its ability to concentrate in other tissues:

". . . it is apparent that this compound possesses chemical or physical properties that bring about a higher concentration of penicillin than that brought about by procaine penicillin in: the erythrocytes and leucocytes of cats, in the lungs of dogs, and in bronchial secretions, spinal fluid, and umbilical cord blood of humans."[2]

. . . about its toxicity:

". . . the toxicity of the compound appears to be of the same order as that of procaine penicillin."[2]

Bibliography

1. Barach, A.L., et al.: Advances in the Treatment of Non-Tuberculous Pulmonary Disease, Bull. New York Acad. Med. *28*:353 (June) 1952.
2. Flippin, H.F.: 'Neo-Penil', a Penicillin Ester with Unusual Pharmacologic and Clinical Properties, report distributed at the Chicago Session of the American Medical Association (June) 1952.
3. Segal, M.S., et al.: Advances in the Management of the Patient with Intractable Bronchial Asthma, paper delivered before the National Tuberculosis Association and the American Trudeau Society, May 28, 1952, at Boston.
4. Segal, M.S., et al.: The Therapy of Chronic Pulmonary Emphysema, GP, in press.

'Neo-Penil' is available at retail pharmacies, in single-dose, silicone-treated vials of 500,000 units.

Smith, Kline & French

Laboratories, Philadelphia

*T.M. Reg. U.S. Pat. Off. for penethamate hydriodide, S.K.F. (penicillin G diethylaminoethyl ester hydriodide)
Patent Applied For

FULL INFORMATION ACCOMPANIES EACH 'NEO-PENIL' VIAL.

ALUM ROCK SANATORIUM

SAN JOSE, CALIFORNIA

TELEPHONE CLAYBURN 8-4921

A Non-profit sanatorium for the treatment of tuberculosis and other diseases of the chest.

Visiting Medical Staff:

Harold Guyon Trimble, M.D., Oakland
Cabot Brown, M.D., San Francisco
J. Lloyd Eaton, M.D., Oakland
H. Corwin Hinshaw, M.D., San Francisco
Gerald L. Crenshaw, M.D., Oakland
Glenroy N. Pierce, M.D., San Francisco
Donald F. Rowles, M.D., Oakland
James Kieran, M.D., Oakland
Robert Stone, M.D., Oakland
William B. Leftwich, M.D., Oakland

Consulting Pathologist

E. Gwyn Roberts, M.D., San Francisco

Medical Director

Buford H. Wardrip, M.D.
Telephone Clayburn 8-4921

Associate Medical Director

C. Gerald Scarborough, M.D.

100 Beds for Crippled Children *200 Beds for Tuberculosis*

ST. JOHNS SANITARIUM, Springfield, Ill.

Complete in every detail. Rates low—because of the services of the Hospital Sisters of St. Francis.

Medical Director
DR. ROBERT K. CAMPBELL

Address
SISTER THEODINE, R.N., Supt.

Cragmor Sanatorium

For the treatment of tuberculosis and diseases of the chest, situated near Colorado Springs in the heart of the Rockies. Ideal year-round climate. Individual apartments, with or without baths. Rates on request.

For detailed information address

Henry W. Maly, M.D., Director
Cragmor Sanatorium
Colorado Springs, Colorado

MEDICAL SERVICE BUREAU

The facilities of the Medical Service Bureau of the American College of Chest Physicians are available to all who are interested in seeking positions or obtaining applicants in the field of chest diseases. If you wish to advertise in Diseases of the Chest, please write to the Medical Service Bureau, American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois, for rates and further information.

POSITION AVAILABLE

Superintendent wanted for 60 bed County Hospital with New York State Civil Service. Active O.P.D. Service. Salary $8,000 with complete family maintenance. Must be citizen of the U. S. and be eligible for New York State license. Please address Box 255A, American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois.

SOUTHWESTERN PRESBYTERIAN SANATORIUM

ALBUQUERQUE, NEW MEXICO

★

A well-equipped Sanatorium in the Heart of the Well Country.

Write for Information and Rates

MARYKNOLL SANATORIUM

MONROVIA, CALIFORNIA

(MARYKNOLL SISTERS)

A sanatorium for the treatment of tuberculosis and other diseases of the lungs. Located in the foothills of the Sierra Madre Mountains. Southern exposure. Accommodations are private, modern and comfortable. General care of patient is conducive to mental and physical well being.

SISTER MARY PIETA, R.N.
Superintendent

E. W. HAYES, M.D.
Medical Director

ANNOUNCEMENT

Postgraduate Course in Tuberculosis

Toronto Hospital for Tuberculosis, Weston, Ontario

OCTOBER 21 - 24, 1952

The National Sanitarium Association is arranging a four-day postgraduate course in tuberculosis for physicians and surgeons to be held for three days at the Toronto Hospital for Tuberculosis, Weston, with an additional day to include the program for the Annual Meeting of the Ontario Laennec Society to be held at the Royal York Hotel, Toronto. Members of the Faculty of Medicine at the University of Toronto as well as other physicians who are authorities in tuberculosis, will participate in the papers to be delivered as well as in the discussions.

Subjects to be considered will include advanced knowledge of the bacteriology and pathology of tuberculosis, epidemiology, differential diagnosis of pulmonary and other forms of tuberculosis, the medical and surgical treatment of the usual forms of tuberculosis encountered by physicians and surgeons engaged in sanatorium practice, private practice in internal medicine, thoracic, orthopedic, and genito-urinary surgery as well as in public health and allied fields.

Registration Fee for the Course will be $40.00 payable to the National Sanitarium Association. That amount will include attendance at all sessions at Weston and in Toronto, transportation between Toronto and Weston, three luncheons and one dinner. This fee should accompany each application.

Each person attending should arrange and reserve living accommodations as required, in Toronto. Minimum of 20 and maximum of 50 applications will be accepted. Early application is desirable.

For further information with provisional list of subjects and application form please write to: Medical Supt., Toronto Hospital for Tuberculosis, Weston, Ontario.

COLLEGE EVENTS

Intermin Session, American College of Chest Physicians, Denver, Colorado, November 30, December 1, 1952.

19th Annual Meeting, American College of Chest Physicians, Hotel New Yorker, New York City, May 28-31, 1953.

Wisconsin Chapter Meeting, October 5, 1952.

Chicago Postgraduate Course, October 6-10, 1952.

North Carolina Chapter Meeting, October 23, 1952.

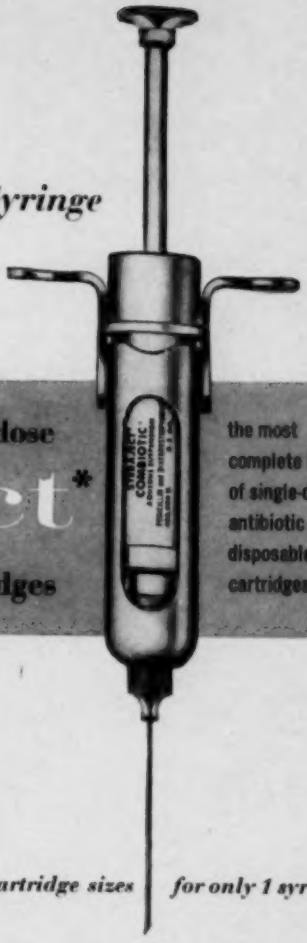
New York Postgraduate Course, November 10-14, 1952.

Philadelphia Postgraduate Course, March 23-27, 1953.

Potomac Chapter Meeting, April 10, 1953.

NEW *Pfizer Steraject Syringe*

holds 2 cartridge sizes



sterile, single-dose

Steraject*

disposable cartridges

the most complete line of single-dose antibiotic disposable cartridges

Steraject Penicillin G Procaine Crystalline in Aqueous Suspension (300,000 units)

Steraject Pencillin G Procaine Crystalline in Aqueous Suspension (1,000,000 units)

Steraject Combiotic* Aqueous Suspension (400,000 units Penicillin G Procaine Crystalline, 0.5 Gm. Dihydrostreptomycin)

Steraject Dihydrostreptomycin Sulfate Solution (1 gram)

Steraject Streptomycin Sulfate Solution (1 gram)

2 cartridge sizes | *for only 1 syringe!*

two cartridge sizes permit *full standard* antibiotic dosage

cartridges individually labeled

ready for immediate use

no reconstitution

for full details, ask your Pfizer Professional Service Representative

Steraject Cartridges:
each one supplied with sterile needle, foil-wrapped

introduced by Pfizer *world's largest producer of antibiotics*

*TRADEMARK, CHAS. PFIZER & CO., INC.

ANTIBIOTIC DIVISION • CHAS. PFIZER & CO., INC. • BROOKLYN 6, N. Y.

SAY YOUR GOODBYES TO THE GI's

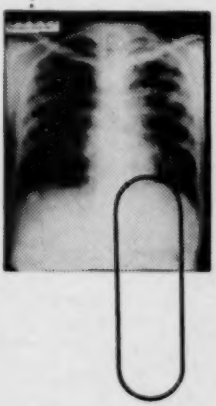
In the past, PAS therapy of tuberculosis has often been hampered by GI side reactions. Now BUFFERED PARASAL, a new, unique development of Panray, has been shown to be less irritating and less toxic than any other dosage form yet devised.

buffered PARASAL® TABLETS

the one dosage form for all your patients

BUFFERED PARASAL TABLETS automatically limit gastric hyperacidity, maintaining their buffering action for 2 to 3 hours. They do not produce "acid rebound" or interfere with normal gastrointestinal processes, and they are usually well tolerated even when other dosage forms are contraindicated.

For *your* patients with PAS-induced GI's, prescribe BUFFERED PARASAL TABLETS. Trial samples and literature will be gladly sent on request.



- **EXTREMELY ECONOMICAL**
- **RAPIDLY ABSORBED**
- **SODIUM FREE**
- **SUGAR-FREE**

Each capsule-shaped, uncoated tablet contains 0.5 Gm. Para-Aminosalicylic Acid in a special acid-buffering system.

THE Panray CORP.

340 CANAL ST., NEW YORK 13, N.Y.